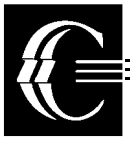
# Ciprico Disk Array . . . . . .

## 6500 Disk Array
## User's Guide



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## Preface

This guide contains all the information needed to successfully install, operate, and maintain Ciprico's 6500 Disk Array subsystems in standard configurations. If you need more technical information for non-standard applications, refer to the *Ciprico 6500 Controller Board Technical Reference* (available from Ciprico).

The standard 6500 array contains eight data drives and one parity drive. The array is equipped with a Wide Ultra SCSI interface, providing transfer rates up to 40MB per second.

Ciprico 6500 arrays readily fit into any standard SCSI platform environment, including DEC, HP, IBM, Silicon Graphics (SGI), Sun, and PC.

**Note** Different model numbers identify 6500 subsystems as single-ended (Model 6511) or differential (Model 6512). In this guide, references to 6500 disk arrays apply to both models unless specifically stated otherwise.

## In This Guide

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| Chapter 1 | Description |
| Chapter 2 | Installation |
| Chapter 3 | Display/Operation Panel |
| Chapter 4 | Maintenance, Troubleshooting & Hardware Replacement |

## Notational Conventions

The following notational conventions are used throughout this guide:

- An uppercase letter "H" following a number indicates that the number is a hexadecimal value, e.g., 20H and FFH.
- In this guide, a byte is defined as an 8-bit quantity.
- **Note** is used in the text to indicate emphasized or supplemental information.
- **Caution** is used in the text to indicate a condition that could destroy data or damage equipment.
- **Warning** is used in the text to indicate a condition that could cause injury to the operator or technician.

## Revision History

| Publication Number | Revision | Date | Description |
|---|---|---|---|
| 21020690 | A | 09.96 | First release |
| 21020690 | B | 11.96 | Updated for production release |

**Figure 1 Revision History**

**Note** The information in this document is subject to change without notice.

## Warning: Fire and Shock Hazards

To prevent the hazards of fire and electrical shock, do not expose this product to any type of moisture.

## Warning: Power Cord

In case of emergency, unplug the power cord from the back of the unit to ensure that no power is applied to the unit.

## Electro-magnetic Compatibility

### United States

This equipment has been tested and found to comply with the limits of a Class A computing device in accordance with the specifications set forth in Part 15 of the FCC Rules. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, use the equipment in another location and/or utilize an electrical outlet different from that used by the receiver. The user should use special accessories, such as a shielded cable, as recommended in these operating instructions, in order to continue to meet FCC emission limits and not possibly interfere with nearby radio and television reception.

### Canada

This digital apparatus does not exceed the Class A limits for radio noise for digital apparatus set out on the Radio Interference Regulations of the Canadian Department of Communications.

Cet èquipement èlectronique ne dèpasse pas la limite de la classe A pour le bruit èlectromagnètique dèfinie pour les appareils èlectroniques numèriques par la règlementation sur les radio interfèrences des Services Canadiens des tèlècommunications.

### Germany

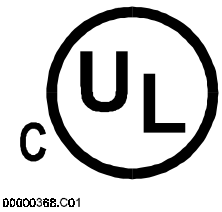
Hiermit wird bescheinigt, dass das Gerät AS6511 und AS6512 Disk Array subsystems in Übereinstimmung mid den Bestimmungen der Vfg 1046/1984 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der 6500 auf Einhaltung der Bestimmung eingeräumt.

## Safety Listings and Certification


This symbol on the nameplate means that the product is “listed” by Underwriters Laboratory Inc.


Ciprico 6500 Disk Array subsystems have been tested and found to be in accordance with Paragraph 3 of the “Equipment Safety Law” of June 24, 1968, the version that is presently valid.




This symbol on the nameplate means that the product is “listed” by Underwriters Laboratory Inc. and has been certified to Canadian standards.

# Table of Contents

# 1

# Description

## In This Chapter

This chapter describes the functions, features, options, and primary components of Ciprico's 6500 Disk Array subsystems.

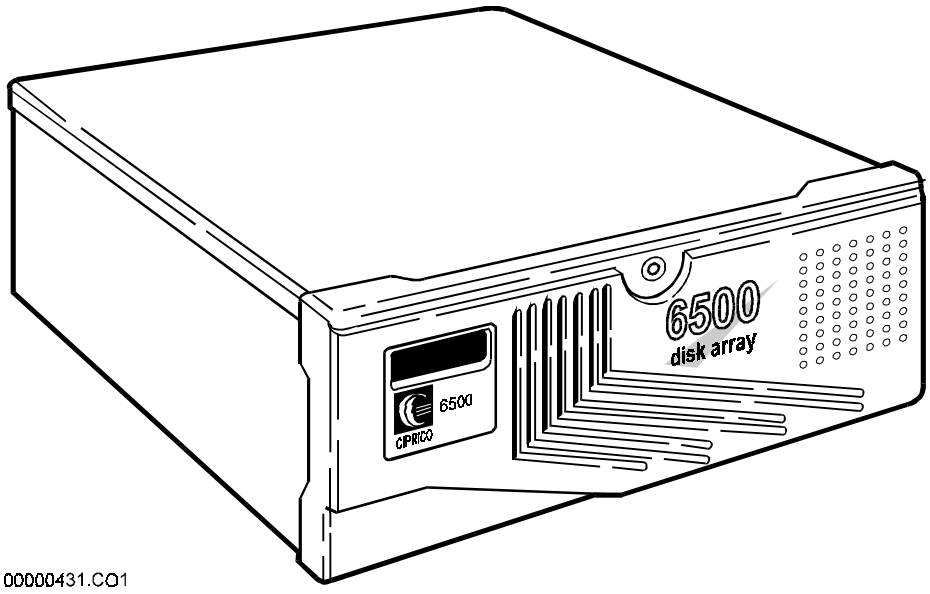



**Figure 2 Ciprico 6500 Disk Array**

## 6500 Disk Array Functions and Application

When high-bandwidth software applications require disk performance rates faster than those provided by single-disk storage systems, Ciprico's 6500 Disk Array can provide economical yet powerful performance, redundancy, and capacity. The 6500 Disk Array provides transfer rates up to 40MB/second.

Each Ciprico 6500 disk array includes an intelligent SCSI/ATA controller, a full-function display/operation panel, a lockable enclosure with power supply and cooling fans, and nine ATA drives—eight for data and one for parity. Available for operation with either single-ended or differential SCSI signal types, Ciprico 6500 arrays can be easily striped or daisy-chained together to provide higher capacities.

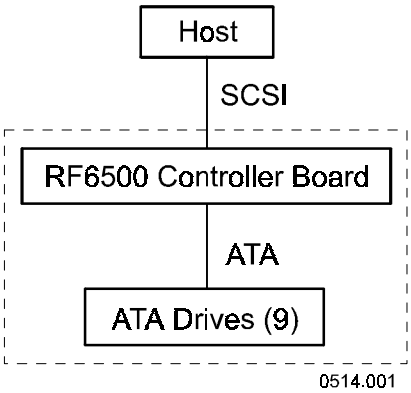
# Features and Options

## SCSI Compatibility

- Conforms to SCSI-2 standards.
- 8- or 16-bit data transfers on host interface.
- Single-ended or differential SCSI interface.
- Compatible with industry-standard SCSI adapters and drivers, including all Ciprico SCSI host bus adapters.

## Controller Board

SCSI-2 to ATA RAID-3 disk array controller with a 16-bit host SCSI interface and 9 ATA interfaces.




## Disk Drives

9 ATA disk drives (8 data, one parity).

## Redundancy

Continued operation after failure of a single data drive.

## Parallel Disk Array Architecture

Ciprico's 6500 parallel disk array communicates with an initiator (or host) via the SCSI-2 industry standard interface. The array's design combines current drive technology with an advanced controller board, where data is "striped" across eight drives at once. Byte-striping involves partitioning of data into bytes, with each byte assigned to a particular drive and all bytes written to the drives simultaneously. Using this method, transfer rates for read/write functions are significantly faster than a single disk drive having the same capacity.

## Parity Drive

Improved reliability and data availability are provided by a dedicated parity drive. As data is striped to the eight data drives, parity data is generated and stored on the parity drive. Parity information is used to verify data integrity when reading from the drives, and to regenerate data if a drive should fail and is replaced. A single drive failure will not degrade overall performance. Use of

the parity drive also significantly increases data availability—the length of time before data is lost due to drive failure.

## 16-Bit Wide Synchronous Transfer

The controller has SCSI-P connectors (per the SCSI-2 standard) that permit 16-bit wide synchronous data transfers over a single SCSI-P cable on the host interface. The 6500 is a Wide Ultra SCSI device (SCSI-3), transferring data at up to 40 MB/second.

## Single-Ended or Differential Signals

Two methods can be used for sending signals on a SCSI bus—*single-ended* and *differential*. Both are functionally equivalent and transparent to the software protocol.

**Note** Single-ended and differential devices must not be combined on the same SCSI bus. Each 6500 array must be initially ordered as either single-ended (Model 6511) or differential (Model 6512).

- Single-Ended Option

  The single-ended option permits the use of a single line for each signal. The line's voltage varies between 0.5 and 3.0 volts DC, with a nominal switching threshold at about 1.4 VDC. Maximum cumulative length of single-ended cabling should not exceed 3.0 meters (approximately 10 feet).

- Differential Option

  The differential option consists of two lines designated as a +SIGNAL and a -SIGNAL. A signal is true when the +SIGNAL is more positive than the -SIGNAL, and false when the -SIGNAL is more positive than the +SIGNAL. The differential method is more immune to noise than the single-ended method, and permits the use of much longer cabling—up to 25 meters (approximately 82 feet).

## Enclosure

Two horizontal mounting options are available—desktop and rack-mount. (For information on rack-mounting the unit, see documentation included with the optional rack-mount kit.)

## Primary Components

The "Primary Components" diagram on page 1-7 illustrates the 6500 disk array primary components described below.

### Enclosure

The standard 6500 enclosure consists of a front cover and an enclosure cabinet, built in a desktop configuration. (An optional rack-mounting kit is available.)

### Air Filter

An air filter is located between the disk drives and the front of the enclosure. It must be periodically cleaned to ensure proper air flow.

### Controller Board

The controller board is designed with a multiple local bus architecture. A master microprocessor commands the board's main processor bus and manages its operations, including command optimization and processing, failed drive processing, and high-level drive operations. The master processor communicates with each drive via an ATA controller circuit. Communications between the master processor and each drive occur on separate but identical drive channels.

### Display/ Operation Panel

The operator interface includes a two-line 32-character LCD display and six control switches.

### Disk Drives

9 ATA disk drives (8 data, one parity).

### Fans and Temperature Sensor

Two fans cool the array. A sensor mounted on the array's controller board monitors the temperature inside the enclosure, and triggers an audio alarm if the temperature rises above the normal operating range. If excessive heat is detected (critical over-temperature), the array will shut down the drives.

### Power Supply

The array's power supply is switch-selectable for 115 or 230 VAC operation. A male connector attaches to the power source.

**Caution** Do not use female power connector.

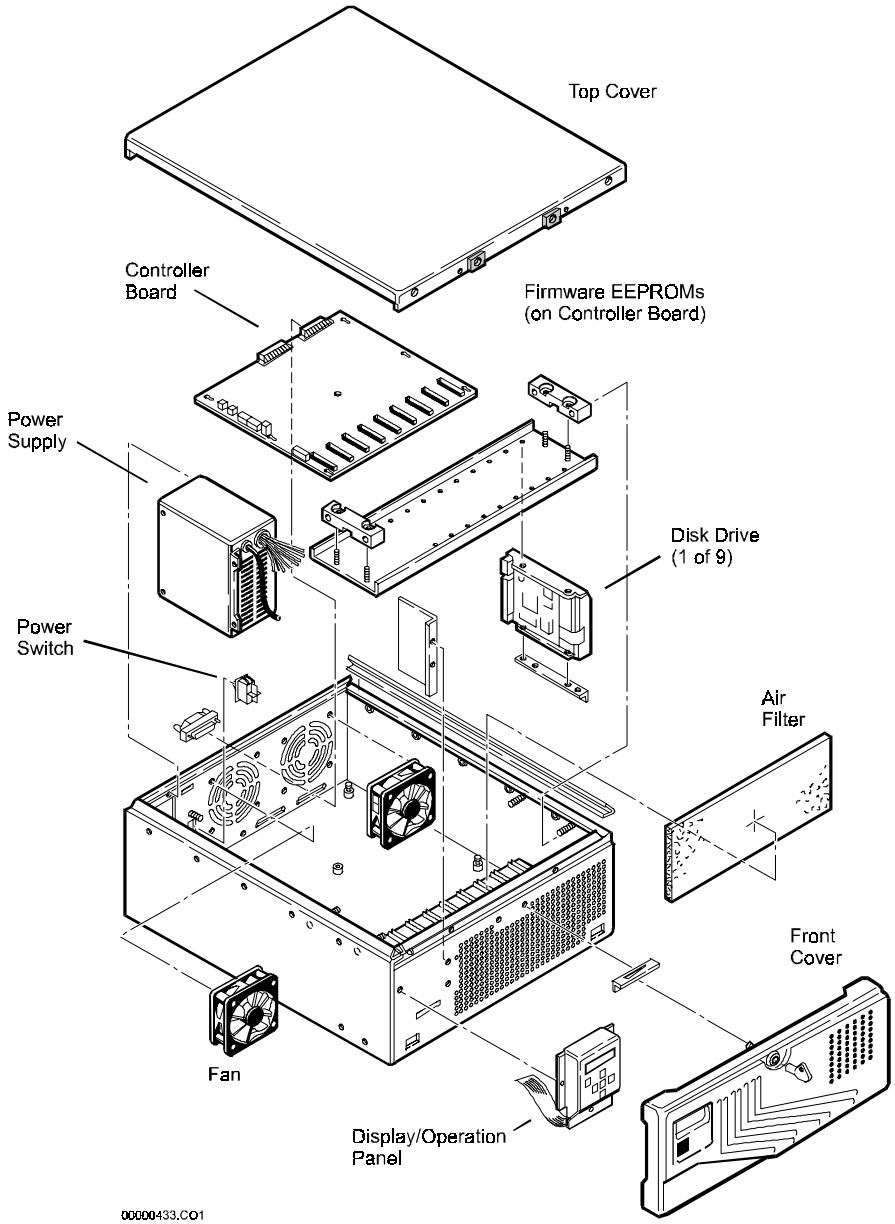



**Figure 3 Primary Components**

## Display/ Operation Panel

As shown below, the 6500 display/operation panel includes a liquid crystal display (LCD) and six membrane control switches.

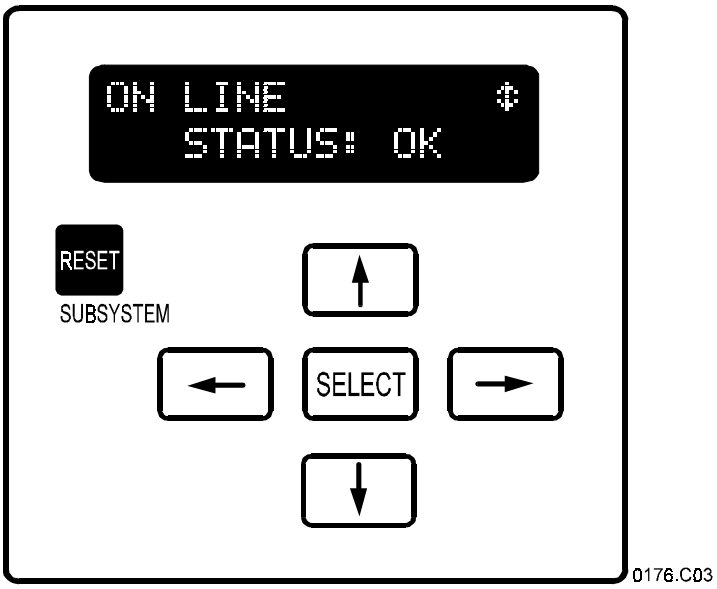



**Figure 4 Display/Operation Panel**

### Liquid Crystal Display (LCD)

The 6500 display/operation panel's LCD indicates real-time array status and error conditions, and is used to enter a wide range of setup parameters and operating commands. The LCD displays 2-line by 16-character messages, and indicates the current position in a tree-structured menu of functions. (See *Chapter 3, Display/Operation Panel*.)

### RESET Switch

This switch initiates a reset, which returns the array to an initial power-up condition. In this power-up state, the firmware and SCSI chip are initialized.

**Caution** The RESET switch initiates a subsystem restart; any activity in progress will be halted without saving information.

### SELECT Switch

The SELECT switch is used to initialize new function selections that appear on the LCD display.

### Navigation Switches (Up, Down, Left, Right)

The four "arrow" switches on the panel are used to step through options in the tree-structured menu, and to make selections when available. Pressing SELECT initializes the currently displayed option.

## Rear Panel Switches and Connectors

This figure illustrates the rear panel components described below.

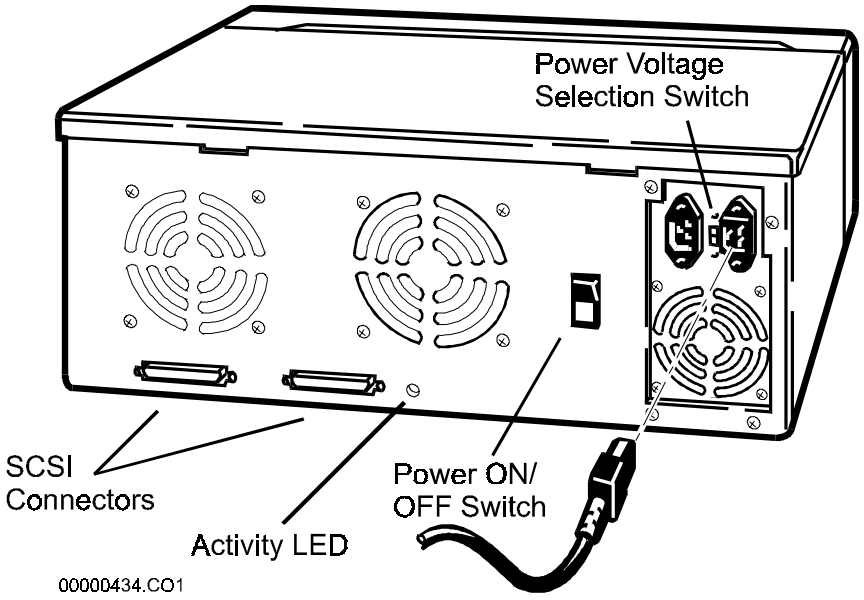



**Figure 5 Rear Panel—6500 Disk Array**

### SCSI Connectors

Two identical 68-pin SCSI-P connectors on the array's controller board enable connection to a SCSI bus from the host.

### Activity LED

A controller board activity LED (located next to the right-most SCSI-P connector) lights when power is applied to the array during the first part of the Built-In Self Test (BIST) until the microprocessor extinguishes it. This LED also flashes on a BIST failure. After completion of BIST, it lights whenever the controller board is busy with a SCSI command.

### Power ON/ OFF Switch

The array’s power ON/OFF switch is located on the rear panel next to the power supply.

### Power Cord Connectors

On the power supply, a male connector attaches to the power source.

**Caution** Do not use female power connector.

### Power Voltage Selection Switch

A switch located between the two power cord connectors on the power supply is used to select 115 or 230 VAC operation for the array.

# 2

# Installation

## In This Chapter

This chapter describes a typical installation of the 6500 Disk Array subsystem.

**Note** Instructions for attaching a rack-mount kit to the enclosure are included with the rack-mount kit.

## Installation Procedure

Install the 6500 disk array as follows:

### Step 1. Move Array to Operation Site

Move the array to its intended place of operation. Verify that power and communication cables will be accessible, and that the array will be installed in a properly ventilated, climate-controlled environment with adequate work space around the unit.

### Step 2. Mount Enclosure

- The standard array enclosure is shipped from the factory ready for placement on a desktop. Attach the supplied rubber feet to the bottom of the enclosure, and position the unit properly on a desk or other work surface.
- If you have ordered the rack-mount option, attach the kit to the enclosure as described in the instructions included with the rack-mount kit.

### Step 3. Attach SCSI Cable

Connect one end of the host-to-array SCSI cable to the host system, and the other end to one of the SCSI-P connectors on the rear panel of the array. To ensure a secure connection, attach the cable connectors to both the host and the array using the small thumbscrews on each connector.

### Step 4. Terminate SCSI Bus, if Necessary

If the array is located at the end of the SCSI bus, or if the array is the only peripheral device on the bus, install a termination pack (see the figure below.)

The termination pack will be either single-ended or differential, depending on the type of array you are installing. Attach the appropriate termination pack to the open SCSI-P connector on the rear panel of the array enclosure.

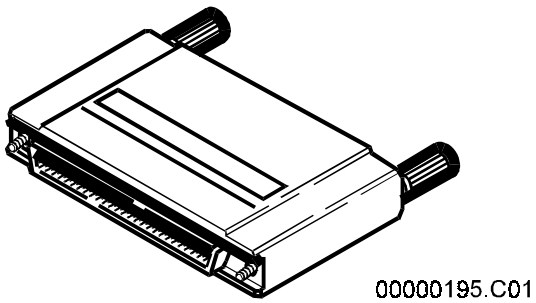



**Figure 6 SCSI-P Termination Pack**

### Step 5. Set Array Input Voltage Switch

Before you connect the array's power cord to an AC outlet, you must set the array power supply's input voltage selection switch to the proper position: the "115" setting for 100-120 VAC, or the "230" setting for 200-240 VAC.

The power supply's input voltage selection switch is located between the two power cord connectors on the rear panel of the array.

**Caution** If the input voltage selection switch is not in the correct position, the array power supply will be damaged when power is applied.

### Step 6. Attach Power Cord

First, verify that the array power ON/OFF switch on the rear panel of the enclosure is in the OFF position. Then plug the power cord into the appropriate connector on the rear panel of the array. Plug the other end of the power cable into the power source.

**Caution** The standard power cord provided with the array is for use in the United States and Canada. If necessary, replace the power cord with one that meets local safety and electrical standards.

### Step 7. Power Up the Array

Move the power switch on the rear panel of the array enclosure to the ON position.

### Step 8. Check Array Status

Observe the display/operation panel for the following start-up displays and status indications.

#### Drive Status

At array reset or power-up, the display/operation panel will cycle through a series of displays that show the status of each drive in the array.

Drives in the array are numbered from right to left, with drive number 1 representing the parity drive and drives 2-9 representing the eight data drives.

9 8 7 6 - 5 4 3 2 - 1

(Drive 1 = Parity Drive)

### Drive Status Codes

The following codes on the display/operation panel indicate drive status:

| Code | Drive Status |
|---|---|
| O | OFF |
| S | Spinning |
| G | Good (Tested OK) |
| T | Testing |
| R | Ready |
| U | Unformatted for Array |
| X | Out of Order |
| ? | Unknown Status |
| F | Failed |

**Table 1: Drive Status Codes**

- At array reset or power-up, a Built-In Self-Test (BIST) will run. During BIST, the drive status display reflects the test stage that each drive is passing through. Under normal conditions, each drive passes through stages OFF, Spinning, Testing, Good, and then Ready, as listed above.
- When all drives are in the same state, an English-language status message will appear on the display/operation panel.
- During the spin-up process, all drives in the array reach their normal operating speed and each drive is tested. When testing and spin-up are complete, the STATUS: OK message appears.

00000211.C03

## Step 9. Configure the Array

Ciprico ships 6500 arrays with default settings designed to suit most operating environments. If necessary, you may reconfigure the array using the display/operation panel. (Chapter 3 in this guide describes how you can use the display/operation panel to verify or change the array's operating parameters.)

In most situations, you will only have to reconfigure two parameters:

- Array SCSI ID—Each device on the SCSI bus must have a unique ID.
- UNIT ATTENTION reporting—SCSI drivers in some systems do not handle this parameter correctly and it may have to be disabled.

## Step 10. Power Up the Host System

When the 6500 array has been properly configured, power up the host computer.

# 3

# Display/Operation Panel

## In This Chapter

This chapter describes the options and functions available with the 6500 Disk Array display/operation panel. The panel is used to observe current array status, change operating parameters, and manually control the array.

## Controls and Indicators

The display/operation panel includes an LCD display and six membrane control switches.

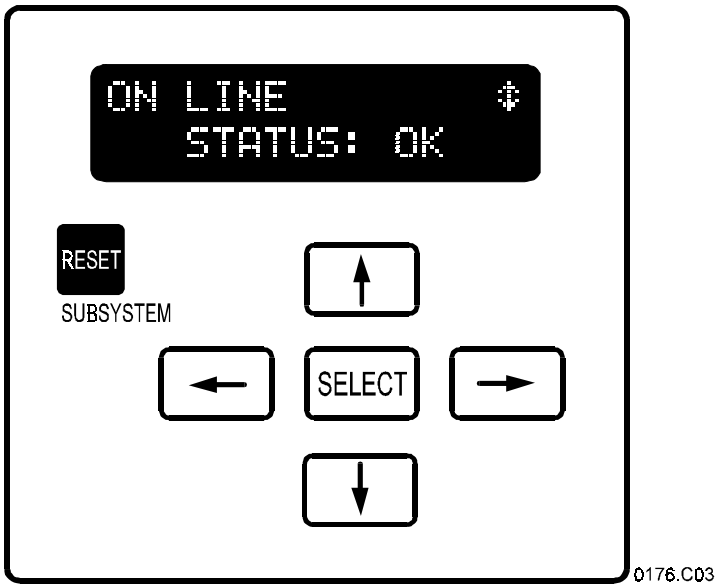



**Figure 7 6500 Display/Operation Panel**

- The LCD displays 2-line by 16-character messages that include directional arrows showing you which switches to use for navigation through the menu or for function selection.
- The RESET switch returns the array to an initial power-up condition in which the firmware and SCSI chip are initialized. Any in-progress array activity will be halted without saving.
- The SELECT switch is used to activate or initialize the currently displayed option or function.
- Four “arrow” switches are used to step through options in the tree-structured menu, and to make selections when available.

# Operation Guidelines

## Array Power-Up and Built-In Self-Test (BIST)

When the array is powered up, the display/operation panel turns on and a Built-In Self-Test (BIST) is executed. Text descriptions for most of the tests briefly appear on the panel as the tests are performed. This process takes approximately 10 seconds, after which the drives in the array are started and begin to spin up. When this process is finished, the display should look like this:

00000211.C03

## Initial Display

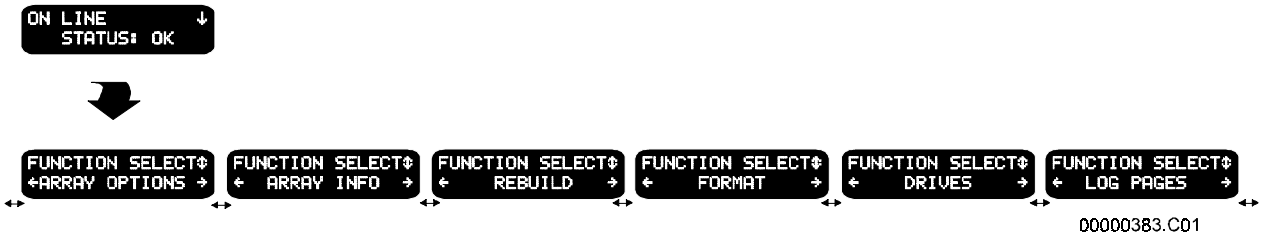
Normally, the initial display appears as shown above: ON LINE (or assigned array name) STATUS: OK. If a failure occurs with any of the drives in the array, however, the bottom line will show the status of each of the nine drives in descending order, from left to right. For example, an array with a failed drive 6 would display: RRRF-RRRR-R (data drives 9876-5432 and parity drive 1). The down arrow at the right end of the top line indicates that menu selections are available only in that direction.

## Tree-Structured Menu

The first level in the tree (below the initial display, entered by pressing the down arrow once) is the FUNCTION SELECT level, which divides the menu tree into the categories shown in the figure below.

"Menu Structure (1 of 5—Array Options)" on page 3-6 illustrates the entire menu structure. The "Display Key" on "Menu Structure (2 of 5—Array Options)" on page 3-7 explains which arrows are enabled for each menu.

**Note** See the Display/Operation Panel Quick Reference included with the equipment for an abbreviated version of the diagrams on the following pages.



00000383.C01

**Figure 8 Function Selection Options**

## Changing or Selecting a Menu Option

Display/operation panel options or parameters currently in use by the array are identified by an asterisk (*) on the display. Change or select a menu option as follows:

1. Use the directional arrows on the keypad to navigate to the menu option that you want to select or change.
2. Press and release the left or right arrow until the selection you want appears on the display.
3. Press SELECT to “lock in” this new selection. An asterisk will appear in front of the new selection.
4. Press the appropriate directional arrows on the keypad to navigate to the next display that you want to change or select.

## Saving Changes

When a new function or value is chosen and you press the SELECT key, the change becomes effective immediately. The only time this does not happen is when a command is executing. In this case, the array waits for the command to complete before initializing the new selection.

## Default Settings

Most of the “default” settings discussed on the following pages are factory settings. If you change a setting, be sure to note that your new setting becomes the new “default” setting. Whenever the array is RESET or powered down, it will retain the same value for each parameter that was in effect before the RESET or power-up. There are two exceptions:

- ON/OFF LINE will always revert to ON LINE
- REBUILD% will always revert to 99%

## Menu Option Descriptions

The remainder of this chapter lists and describes the menu selections and options available on the 6500 array display/operation panel.

The complete tree structure of the display/operation panel menu system is shown in the diagrams on the following pages. The descriptions following the diagrams are grouped under the primary first-level selections in the menu system:

- ARRAY OPTIONS
- ARRAY INFORMATION
- REBUILD
- FORMAT
- DRIVES
- LOG PAGES

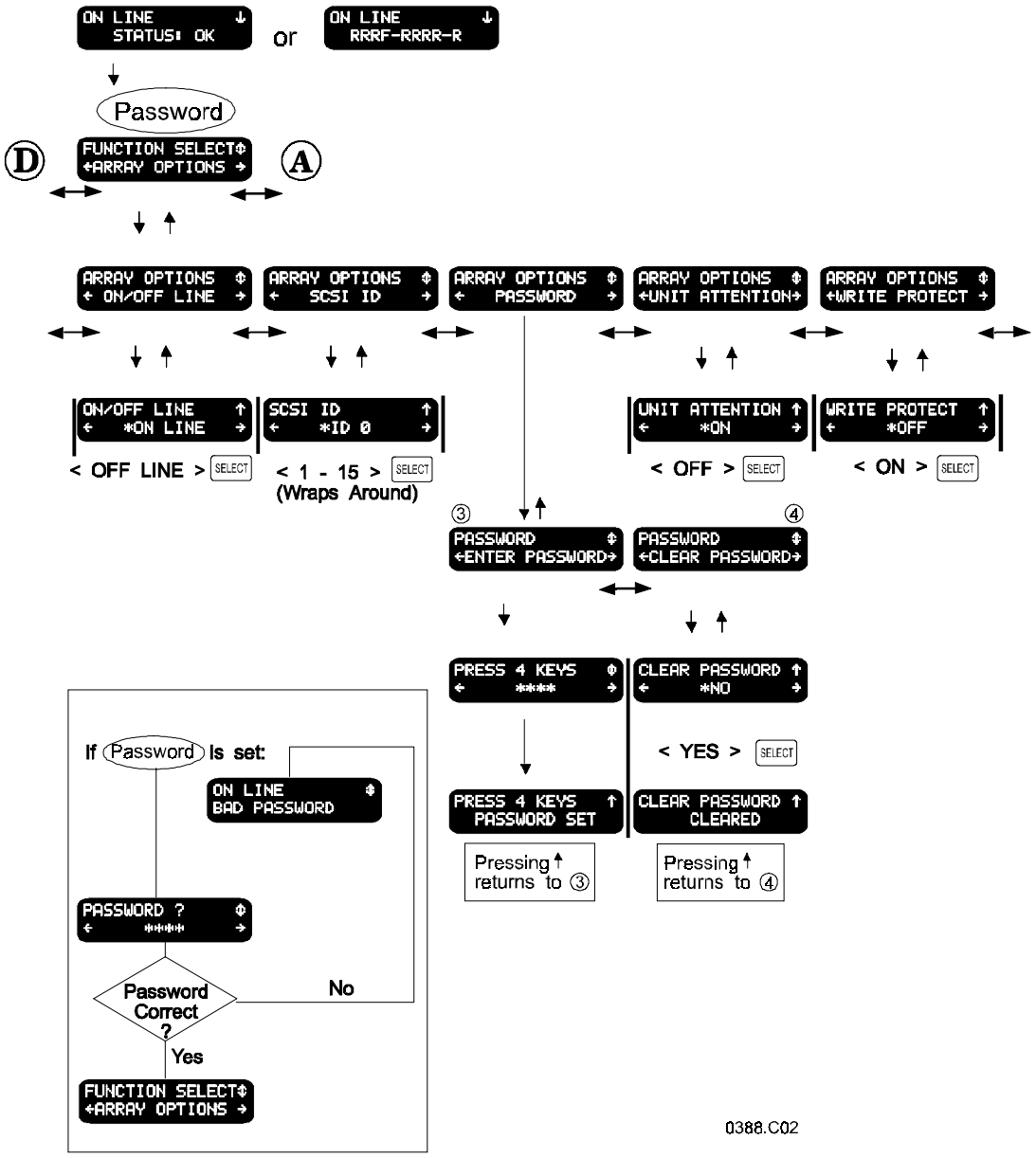



**Figure 9 Menu Structure (1 of 5—Array Options)**

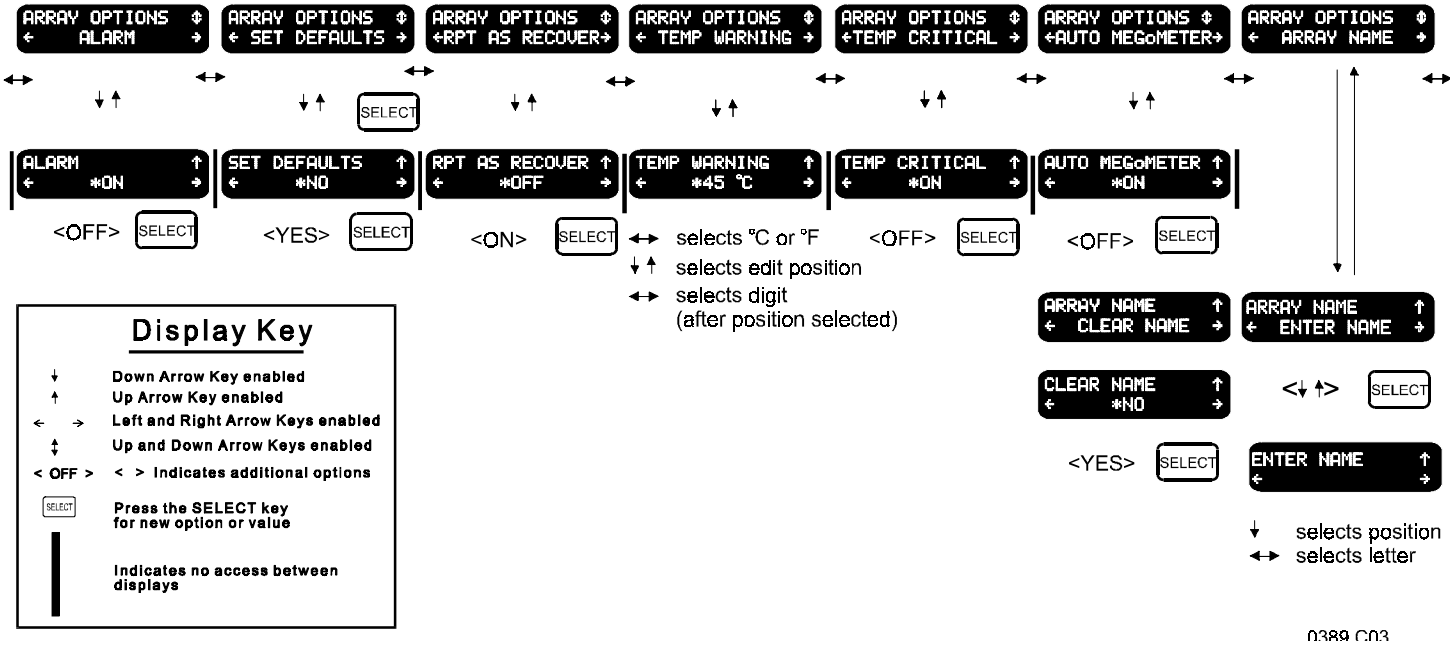



**Figure 10 Menu Structure (2 of 5—Array Options)**

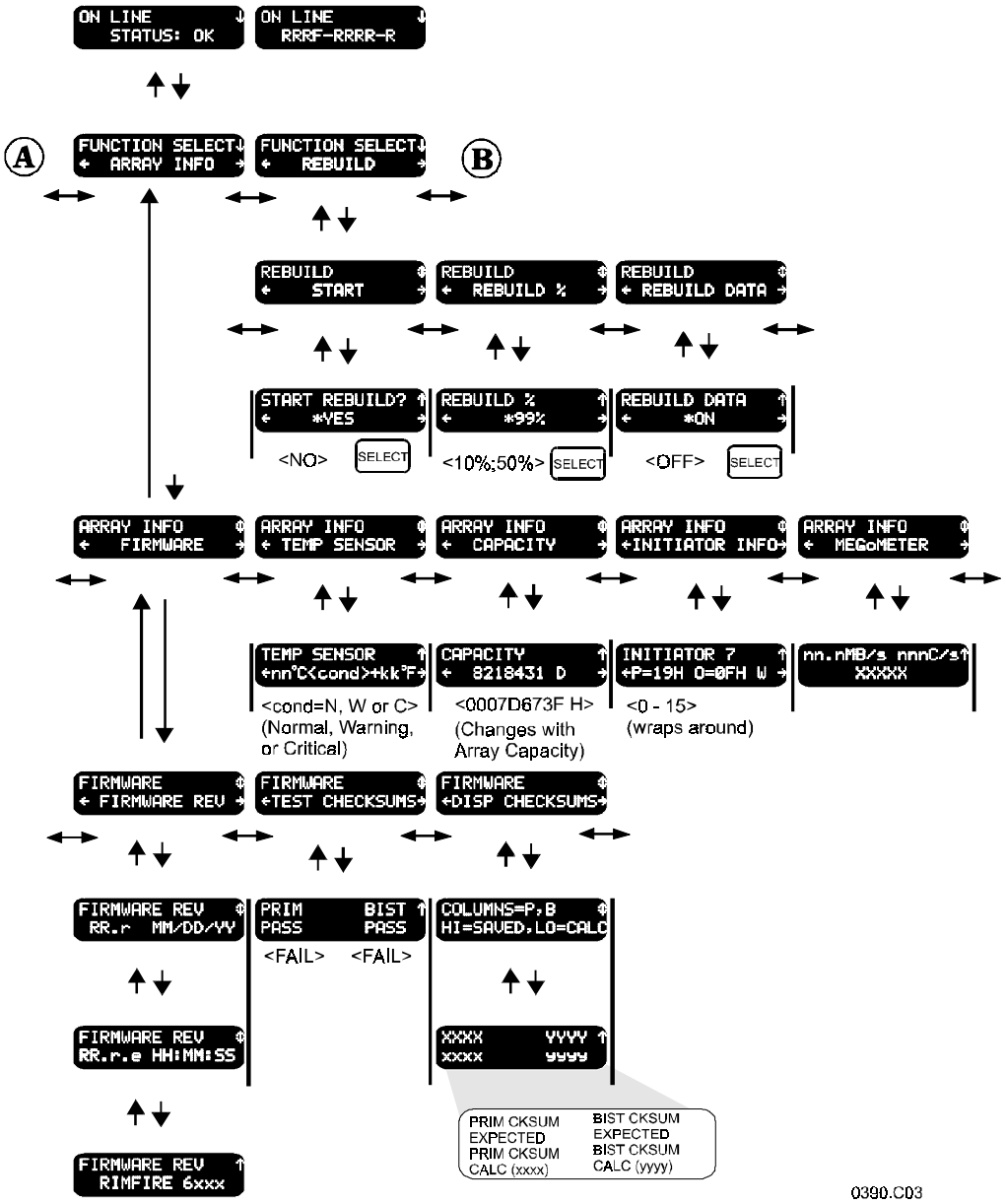



**Figure 11 Menu Structure (3 of 5—Array Info & Rebuild)**

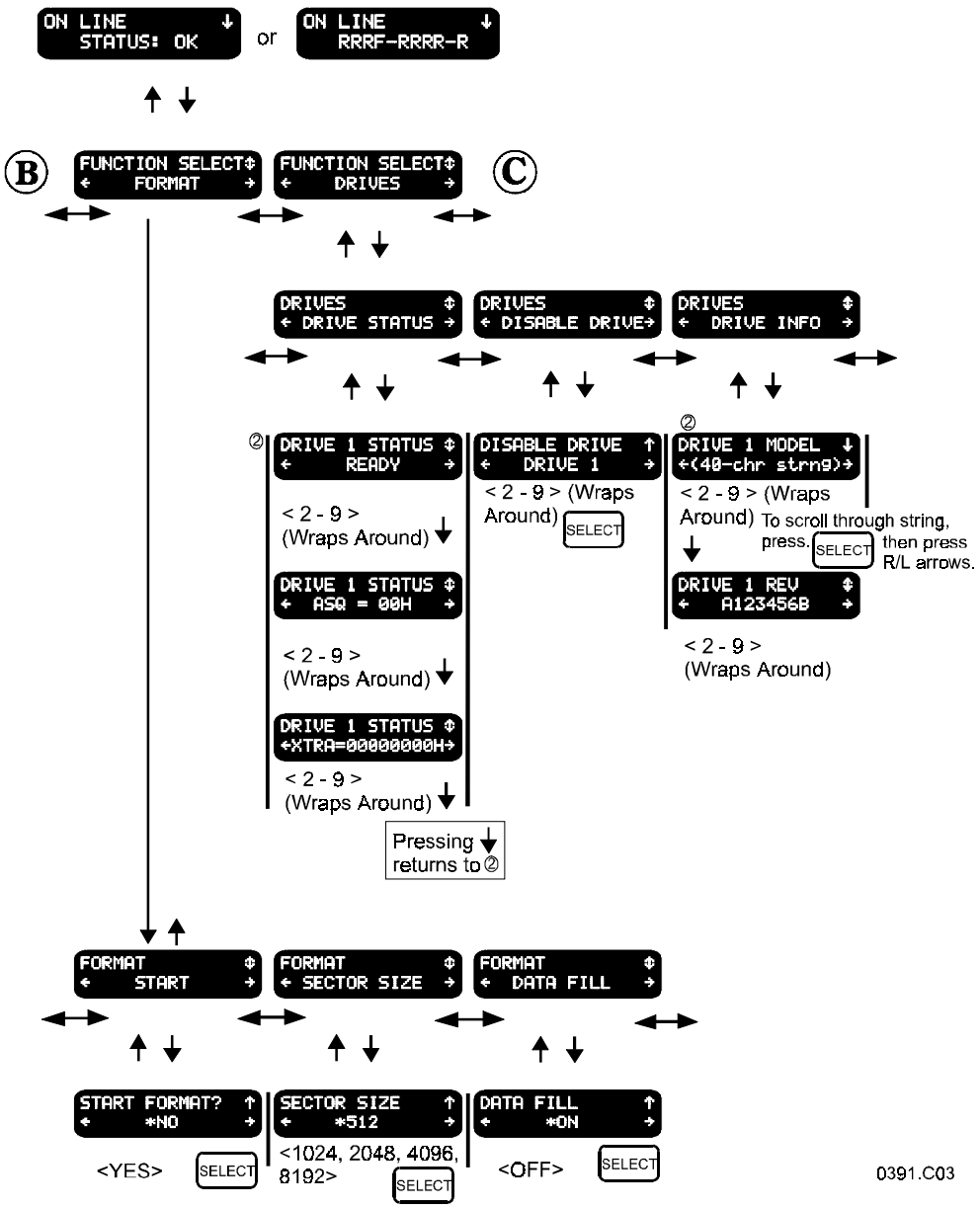



**Figure 12 Menu Structure (4 of 5—Format & Drives)**

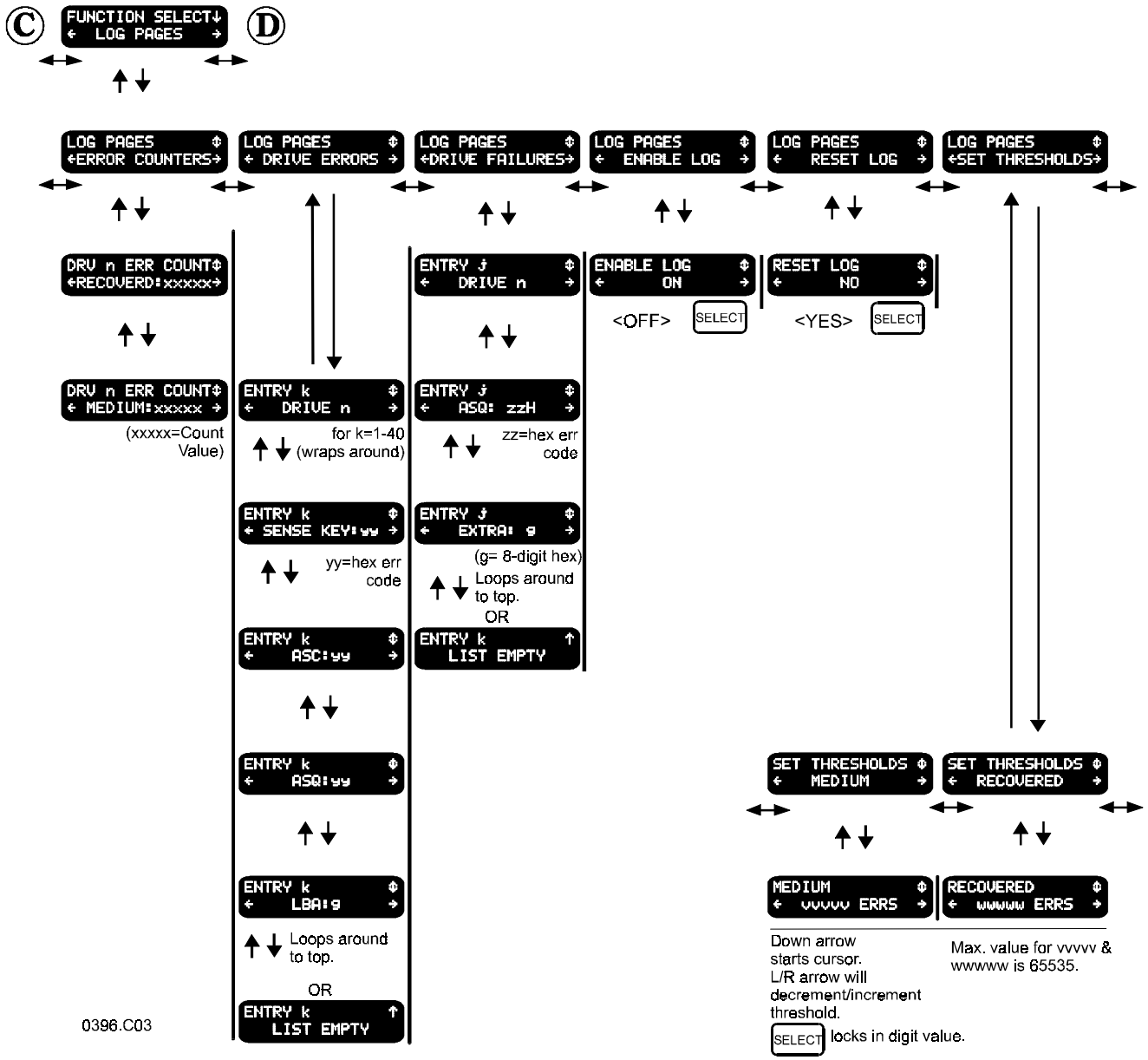



**Figure 13 Menu Structure (5 of 5—Log Pages)**

## ARRAY OPTIONS

From FUNCTION SELECT, use the left/right arrow keys to select ARRAY OPTIONS (see "Menu Structure (1 of 5—Array Options)" on page 3-6 and "Menu Structure (2 of 5—Array Options)" on page 3-7). Array options include:

| OPTION | DEFAULT SETTING |
|---|---|
| ON/OFF LINE | ON LINE (or assigned array name) |
| SCSI ID | 0 |
| PASSWORD | (none) |
| UNIT ATTENTION | ON |
| WRITE PROTECT | OFF |
| ALARM | ON |
| SET DEFAULTS | NO |
| RPT AS RECOVER | OFF |
| TEMP WARNING | 45 degrees C |
| TEMP CRITICAL | ON |
| AUTO MEGOMETER | OFF |
| ARRAY NAME | (blank) |

**Table 2: Array Options**

### ON/OFF LINE

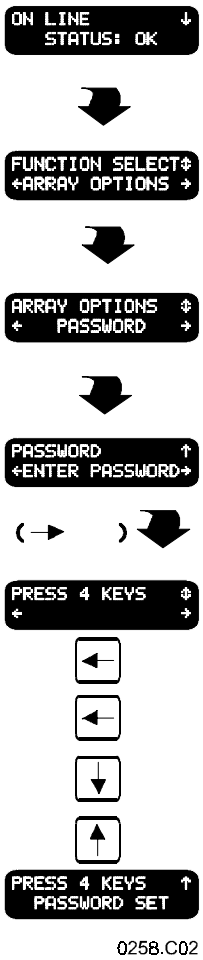
When ON LINE, the array is ready to receive commands from the system it is connected to.Take the array OFF LINE if you want to prevent user access while performing a rebuild or other maintenance.

### SCSI ID

Each device on the SCSI bus must have a unique ID. This option allows you to set the array's SCSI ID from 0 to 15. This is typically set to 0 unless multiple arrays are daisy-chained together or the ID of the host SCSI port is zero.

## PASSWORD

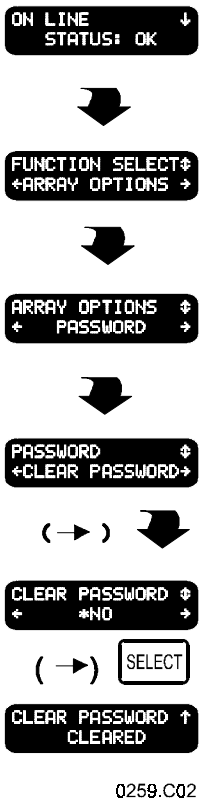
The password option allows you to set or clear the array's password protection feature. When set, the password is a user-entered series of four display/ operation panel keystrokes—any key can be used **except** the RESET key.




### Enter a New Password

Enter a new password as follows:

1. Press the down arrow, then press the right or left arrow until FUNCTION SELECT/ARRAY OPTIONS appears.
2. Press the down arrow.
3. Press the right or left arrow until PASSWORD appears.
4. Press the down arrow to view the ENTER PASSWORD menu. If CLEAR PASSWORD is displayed, press the right key once to show ENTER PASSWORD.
5. Press the down arrow.
6. Press four keypad keys in sequence (do not use the RESET key in this sequence), and be sure to note the keys you enter (see example at left: left, left, down, up). This four-key sequence will be your new password. As each password key is pressed, an asterisk is displayed in the panel. When the fourth key is pressed, PASSWORD SET is displayed.




## Clear Password

Clear a password as follows:

1. Press the down arrow, then press the right or left arrows until FUNCTION SELECT/ARRAY OPTIONS is displayed.
2. Press the down arrow.
3. Press the right or left arrows until the PASSWORD menu is displayed.
4. Press the down arrow to view the CLEAR PASSWORD menu. If ENTER PASSWORD is displayed, press the right key once to show CLEAR PASSWORD.
5. Press the down arrow.
6. Press the right arrow once to display YES, then press SELECT. The panel immediately displays CLEARED, and password protection is cleared from the array.

### UNIT ATTENTION

If your system cannot handle SCSI bus errors reported with a SCSI UNIT ATTENTION signal, use this option to keep the array from doing so. UNIT ATTENTION is typically set to ON. Setting UNIT ATTENTION to OFF will result in some error messages, such as Drive Failure and Reset, **not** being reported over the SCSI bus. When active, an alarm will sound and a message will display.

### WRITE PROTECT

Setting WRITE PROTECT to ON prevents any data from being written to the array. This is typically set to OFF.

### ALARM

This menu allows turning the audible alarm on and off. The audible alarm turns on when any of the following conditions occur in the array:

- Disk drive fails
- Over-temperature sensor detects excessive heat

To silence the alarm temporarily when it is active, press any key to turn off the alarm. The ALARM setting is typically set to ON.

### SET DEFAULTS

Setting the SET DEFAULTS to YES returns the array to its factory default settings for WRITE PROTECT, UNIT ATTENTION, ALARM, RPT AS RECOVER, ARRAY NAME, TEMP WARNING, TEMP CRITICAL, and MEGOMETER. The default for this option is NO.

### RPT AS RECOVER

RPT AS RECOVER is set to ON when it is necessary for Unit Attention conditions to be reported as Recovered Errors rather than with a Unit Attention. This is determined by the needs of the operating system and the driver. Default is OFF.

### TEMP WARNING

Use this option to change the temperature at which the array will issue an alarm and warning display (W), the warning threshold for overheating conditions. This temperature warning can be set in degrees Celsius or Fahrenheit, and refers to the temperature detected by the sensor on the controller board.

### TEMP CRITICAL

In addition to the temperature warning (W), there is another, higher temperature at which the array's drives are automatically shut down (50 degrees Celsius). This is the critical (C) over-temperature threshold. The TEMP CRITICAL menu option allows you to enable or disable this automatic shutdown feature. Positions are ON and OFF. (When OFF, the unit attention and alarm are still issued but the array does not shut down.)

### AUTO MEGOMETER (ON/OFF)

The megometer feature displays the array's current data transfer rate in megabytes per second. Because transfer rates vary considerably from moment to moment, the rate shown is actually the average transfer rate for a two-second period. This averaging yields a more accurate representation of overall transfer performance.

When the megometer is ON, the transfer rate is the default display unless some other message preempts it. When you switch the megometer display OFF, the transfer rate will not display until you switch it ON again.

**Note** When you select the auto megometer display, it will not take effect until the next subsystem reset or power cycle has occurred.

### ARRAY NAME

Use this option to specify a logical name or designator for the array. This feature is a convenience where multiple array units are used and need to be distinguished from one another with assigned names. The array name is a user-definable 14-character string, and is displayed on line 1 in place of ON LINE. The displayed name will be replaced by error messages or menu selection titles when active.

## ARRAY INFORMATION

From FUNCTION SELECT, use the left/right arrow keys to select ARRAY INFORMATION (see "Menu Structure (3 of 5—Array Info & Rebuild)" on page 3-8). These display-only selections let you view the following array information:

FIRMWARE

TEMPERATURE SENSORS

CAPACITY

INITIATOR INFORMATION

MEGoMETER

### FIRMWARE

The FIRMWARE menu gives you access to three firmware parameters: firmware revision level (FIRMWARE REV); the results of a checksum test (TEST CHECKSUMS); and a display of the hexadecimal tallies of the checksum test (DISP CHECKSUMS).

#### FIRMWARE REV

Displays the revision level of the firmware residing in the array's firmware PROM device. Two submenus display the date and time associated with the firmware revision, and a third submenu displays the model number of the array.

#### TEST CHECKSUMS

This item and its submenu display, as PASS or FAIL, the results of a test in which expected checksums are compared to actual calculated checksums of the current contents of the Primary (PR) firmware buffers, and the BIST buffer. Matching checksums for a buffer verify that the contents of that buffer have not changed and it passes the test.

#### DISP CHECKSUMS

This item is similar to the TEST CHECKSUMS item except that, instead of showing a PASS or FAIL condition, the actual checksums are displayed in hexadecimal. Two submenu items are associated with DISP CHECKSUMS. In the second submenu item, there are four entries: at the upper left, the expected checksum from the primary buffer appears; at the lower left, the calculated checksum for the primary buffer is shown; at the upper right, the expected BIST checksum appears; and at the lower right, the calculated BIST checksum appears.

### TEMP SENSOR

Displays the temperature detected by the sensor (on the controller board) in degrees Celsius and Fahrenheit.

## CAPACITY

Displays the logical block number of the last data block in the array. A value followed by D indicates a decimal number; a value followed by H indicates a hex number.

To calculate the capacity of the array, add one to the number displayed. For example, a display with 4207836 D in an array formatted with 512 as the sector size indicates that the array's capacity is 4,207,837 blocks of 512 bytes each.

## INITIATOR INFO

A SCSI-2 bus can have up to 16 devices attached to it, with some devices acting as initiators of SCSI commands, and some acting as targets. The array is always a target.

The SCSI protocol allows targets and initiators to negotiate the width of the bus to be used when transferring data, the transfer rate, and also whether the transfer will be synchronous or asynchronous. This information is stored by the array for each initiator on the SCSI bus under Array Information.


0430.001

**P** is the Transfer Period

**O** is the Synchronous Offset

**W** indicates that a wide 16-bit bus will be used

**N** indicates that a narrow 8-bit bus will be used

To determine the Transfer Rate from the Transfer Period:

1. Translate the hexadecimal Transfer Period into decimal. For example, 19H equals decimal 25.
2. Multiply the decimal value by 4 to get the Transfer Period in nanoseconds (25 x 4 = 100).
3. Take the reciprocal of this value to get the Transfer Rate in Megahertz ($1/100\text{-}^{9}$ = 10 Megahertz).
4. Multiply by the bus width (1 or 2 bytes) to get the bus burst transfer rate, e.g., 10 MHz x 2 bytes wide = 20MB/second.

**Note** Because the 6510 employs Wide Ultra SCSI technology, the SCSI specification requires a slight variation to the computations above. Wide Ultra SCSI technology is designated as 0CH or decimal 12, when in fact it is slightly longer at 12.5. When the designated period is multiplied by 4 to get the Transfer Period in nanoseconds, the result is 48. In reality it is 50, which is the value whose reciprocal 1/50 nanoseconds equals 20 Megahertz (20MB/second).

The Synchronous Offset represents the number of bytes a SCSI ACK signal may lag a REQ signal. 16 (10H) is the maximum Offset allowed. Although communications allow up to a 16 byte offset, each byte is always acknowledged. For additional information, see the SCSI-2 specification.

## MEGoMETER (DISPLAY)

The MEGoMETER displays the transfer rate in megabytes per second. Because transfer rates vary considerably moment to moment, the rate shown is actually the average of transfer rates for a two-second period. This averaging yields a more accurate representation of the overall transfer performance.

## REBUILD

From FUNCTION SELECT, use the left/right arrow keys to select the following REBUILD functions (see "Menu Structure (3 of 5—Array Info & Rebuild)" on page 3-8). Use the display/operation panel rebuild options listed below as described in Chapter 4 of this guide.

**Caution** If a disk in the array fails, replace the drive and perform a rebuild as soon as possible. A rebuild can be performed without taking the array off-line. See Chapter 4 for drive replacement and rebuild instructions.

### REBUILD DATA

Your selection for the REBUILD DATA parameter determines whether or not the data from the failed drive will be reconstructed on the new replacement disk drive. ON means the data will be rebuilt; OFF means the data will not be rebuilt.

**Caution** DATA ON should always be selected for a data rebuild. Rebuilding with this selection OFF may result in data corruption and/or inter-drive parity errors.

### REBUILD%

This menu selection allows you to select the percentage of processing time the array will dedicate to the rebuilding process: 10%, 50%, or 99%. The lower the percentage, the longer the rebuild will take. The default setting is 99%.

### START

This selection must be set to YES before you press SELECT to rebuild a drive.

## FORMAT

From FUNCTION SELECT, use the left/right arrow keys to select FORMAT ("Menu Structure (4 of 5—Format & Drives)" on page 3-9).

Each disk in the array is written with a special "system sector" during formatting that holds information about the array. For this reason, an array must be formatted before it can be used. All arrays are formatted completely before shipment. You must format the array only if, on power-up or reset, you see a display similar to the following, which indicates that drives 9, 6, 5, and 4 in the array are unformatted.


0373.C02

**Note** If this type of display appears, format drives as described in Chapter 4 of this guide.

### SECTOR SIZE

The sector size options for 6500 arrays, expressed in bytes per sector, are 512, 1024, 2048, 4096, and 8192. Factory default setting is 512.

### DATA FILL

This option writes a pattern to the data disks in the array, generates parity data, and writes the parity data to the parity disk. If you do not choose to use data fill, you may get an inter-drive parity error if you perform a read operation before a write operation after format. The settings for this option are ON and OFF. When set to ON, the array writes data to the drives in order to initialize the parity drive. The default setting is ON.

### START

This selection must be set to YES before you press SELECT in order to format the array.

## DRIVES

From FUNCTION SELECT, use the left/right arrow keys to select DRIVES (see "Menu Structure (4 of 5—Format & Drives)" on page 3-9).

These menus let you view the current drive status, disable a disk drive, and view information on the drive's model number.

### DRIVE STATUS

The read-only DRIVE STATUS option typically displays READY for each drive. Any of the drive status options listed below could be displayed, however. The status for any installed drive can be viewed with this selection.

| Code | Drive Status |
|---|---|
| O | OFF |
| S | Spinning |
| G | Good (Tested OK) |
| T | Testing |
| R | Ready |
| U | Unformatted for Array |
| X | Out of Order |
| ? | Unknown Status |
| F | Failed |

**Table 3: Drive Status Options**

#### ASQ

This menu selection typically displays 00. A non-zero number indicates a failed drive and an ASQ code is associated with the failure. See note below. (This menu selection is display-only.)

#### XTRA

This menu selection is display-only, and typically displays 00000000. A non-zero number indicates a failed drive and an ASQ XTRA code is associated with the failure. See note below.

**Note** In this case, ASQ (Additional Sense Code Qualifier) and ASQ XTRA codes apply to a drive failure condition. These codes are not easily interpreted. Contact your service provider for an explanation if these codes are non-zero.

### DISABLE DRIVE

Use this option to shut down any drive in the array for maintenance or replacement. When you press the SELECT key, the array will spin down the drive. This function is not available if another drive is currently disabled or failed.

**Note** See Chapter 4 for drive replacement and rebuild instructions.

## DRIVE INFO

The DRIVE INFO menu provides access to two submenus which describe the model number of each drive used in the array and the firmware revision of each drive.

Press the down arrow key to advance to the first information menu.

### DRIVE n MODEL

This option displays the model number of the drive. Use the right and left arrow keys to move to the next drive in the array.

### DRIVE n REV

This option displays the drive's firmware revision. Use the right and left arrow keys to move to the next drive in the array.

# LOG PAGES

From FUNCTION SELECT, use the left/right arrow keys to select LOG PAGES (see "Menu Structure (5 of 5—Log Pages)" on page 3-10).

These selections provide access to drive error information contained in SCSI log pages. Three menus in this category (ERROR COUNTERS, DRIVE ERRORS, and DRIVE FAILURES) give access to "pages" of SCSI log entries. Three additional items (ENABLE LOG, RESET LOG, and SET THRESHOLDS) are commands that allow you to manipulate or control these internal log pages. These commands affect all log pages and cannot be applied deferentially to individual log pages.

## ERROR COUNTERS

For each drive, this menu gives access to a tally of recovered errors and a tally of medium errors. Medium errors are non-recoverable errors related to flaws in the drive's memory medium material. The ERROR COUNTERS menu item relates to SCSI log page number 3.

### DRV n ERR COUNT / RECOVERED

Displays a 5-digit tally of recovered errors for each drive (with a maximum tally of 65,535 errors). "n" is the drive number (n=1-9).

### DRV n ERR COUNT / MEDIUM

Displays a 5-digit tally of medium errors for each drive (with a maximum tally of 65,535 errors). "n" is the drive number (n=1-9).

## DRIVE ERRORS

This item gives access to the error entry for each recorded drive error occurrence. 40 error entries can be stored. For each error occurrence, an error entry number is assigned. The error entry identifies the drive on which the error occurred, gives SCSI codes that describe the error, and tells the location on the drive (logical block address) at which the error occurred, if applicable.

The sense key code gives the primary description of the error. ASC and ASQ codes give additional information about the error entry, but for some error entries, these two codes will not be applicable. Because the 6500 arrays are equipped with ATA drives, they produce ATA error codes. These are translated, on the controller board, into SCSI codes to maintain compatibility with arrays equipped with SCSI drives. The DRIVE ERRORS item relates to SCSI log page number 4.

If no errors have been recorded, the display for this menu item will read DRIVE ERRORS LIST EMPTY.

### ENTRY k / DRIVE n

This item gives you access to error entries by entry number and tells you the drive on which each error occurred (k=1-40, n=1-9).

### ENTRY k / SENSE KEY: yyH

This item gives you the two-digit hexadecimal sense key code for the error entry. Every error will have a sense key code. The sense keys report generic categories of error and exception conditions. Initiators typically use sense keys for high-level error recovery procedures.

### ENTRY k / ASC: yyH

This item displays the two-digit hexadecimal code for the ASC code that applies to the error entry. (ASC = Additional Sense Code.)

### ENTRY k / ASQ: yyH

This item displays the two-digit hexadecimal code for the ASQ code that applies to the error entry. (ASQ = Additional Sense Code Qualifier.)

### ENTRY k / LBA 12345678H

This item specifies the Logical Block Address on the drive at which the error occurred, if applicable. (Some errors are not associated with a specific block location on the drive.) The address is an 8-digit hexadecimal number.

## DRIVE FAILURES

This item gives access to the entry for each recorded drive failure occurrence. Records for the last 16 drive failures can be stored in this log. For each failure occurrence, a failure entry number is assigned. The failure entry identifies the drive on which the failure occurred and gives two kinds of SCSI codes that describe the failure. The first is a two-digit hexadecimal ASQ code (Additional Sense Code Qualifier); the second is an eight-digit hexadecimal EXTRA code. ASQ is a standard category of SCSI error codes; EXTRA codes are diagnostic codes unique to Ciprico. The DRIVE FAILURES item relates to SCSI log page number 5.

If no failures have been recorded, the display for this menu item will read `DRIVE FAILURES LIST EMPTY`.

### ENTRY j / DRIVE n

This item gives you access to drive failure entries by entry number, and tells you the drive on which each failure occurred. (j=1-16, n=1-9)

**ENTRY j / ASQ: zzH** - This item gives you the two-digit hexadecimal code of the ASQ type that applies to the drive failure occurrence. (ASQ = Additional Sense Code Qualifier.)

**ENTRY j / EXTRA: ggggggggH** - This item gives you the eight-digit hexadecimal code of the EXTRA type that applies to the error entry.

## ENABLE LOG

This item lets you enable or disable the logging function by choosing ON or OFF. The factory default setting is ON. If you cycle power, the ENABLE LOG item will come up in the condition it was in when you turned off the array.

## RESET LOG

This command sets all log counters back to zero and sets functions to their default conditions. When you invoke this command, all entries for drive errors and drive failures will be erased. The default setting is NO. To implement this command, use the left arrow key to select YES, then press SELECT. After a reset, this parameter reverts to NO.

## SET THRESHOLDS

This item allows you to view and set thresholds for the number of errors at which the array will automatically shut down a drive. There are separate thresholds for recovered errors and medium errors, but each of these thresholds applies to all nine drives. Factory defaults for both recovered and medium errors are zero, which indicates that the shutdown-on-threshold feature is disabled.

### SET THRESHOLDS / RECOVERD

Gives access to view and set the threshold for triggering of automatic shutdowns because of recovered errors.

### RECOVERED / wwwww ERRS

To set the threshold for recovered errors, press the down arrow. This causes the cursor to flash over the least significant digit of the 5-digit threshold (maximum value = 65,535). To increment the threshold setting, press the right arrow key; to decrement it, press the left arrow key. Press the down arrow again to move to the next digit. When the desired threshold is set, press SELECT.

### SET THRESHOLDS / MEDIUM

Gives access to view and set the threshold for triggering of automatic shutdowns because of non-recoverable medium errors.

### RECOVERED / vvvvv ERRS

To set the threshold for medium errors, press the down arrow. This causes the cursor to flash over the least significant digit of the 5-digit threshold (maximum value = 65,535). To increment the threshold setting, press the right arrow key; to decrement it, press the left arrow key. Press the down arrow again to move to the next digit. When the desired threshold is set, press SELECT.

# 4

# Maintenance, Troubleshooting & Hardware Replacement

## In This Chapter

This chapter contains information you will need for Ciprico 6500 Disk Array maintenance, troubleshooting, and hardware replacement:

- Periodic maintenance guidelines
- Failure detection and troubleshooting guidelines
- Hardware field-replaceable units (FRUs)

# Periodic Maintenance Guidelines

Under normal conditions, the 6500 array requires minimal periodic maintenance. Preventive maintenance consists of periodically checking the operation of cooling fans and cleaning the enclosure's air filter.

## Checking Enclosure Cooling Fan Operation

Periodically inspect the rear panel of the array enclosure to verify that the two enclosure cooling fans are operating properly. Make sure that both fans are spinning, and check for any unusual bearing noises.

If fan operation does not seem normal, first verify that the cooling fans are receiving DC power from the power supply.

If you need to replace one or both enclosure cooling fans, refer to the fan replacement procedures in this chapter.

## Checking Power Supply Cooling Fan Operation

Periodically check the internal fan on the array's power supply to verify that it is operating properly.

## Cleaning the Enclosure Air Filter

To maintain optimum air flow in the array enclosure, clean the air filter twice per year, or more frequently if the environment is dusty or the array is installed in an exposed area.

To clean the enclosure air filter:

1. Remove the front cover and top cover from the array enclosure (see the figure below).
2. The air filter is a flexible piece of foam material located between the front of the enclosure and the drives. Carefully flex and remove the material from its mounting position in the enclosure.
3. Clean the filter with a vacuum cleaner.
4. Insert the clean filter back into its mounting position in the enclosure.
5. Replace and secure the top cover and front cover on the enclosure.

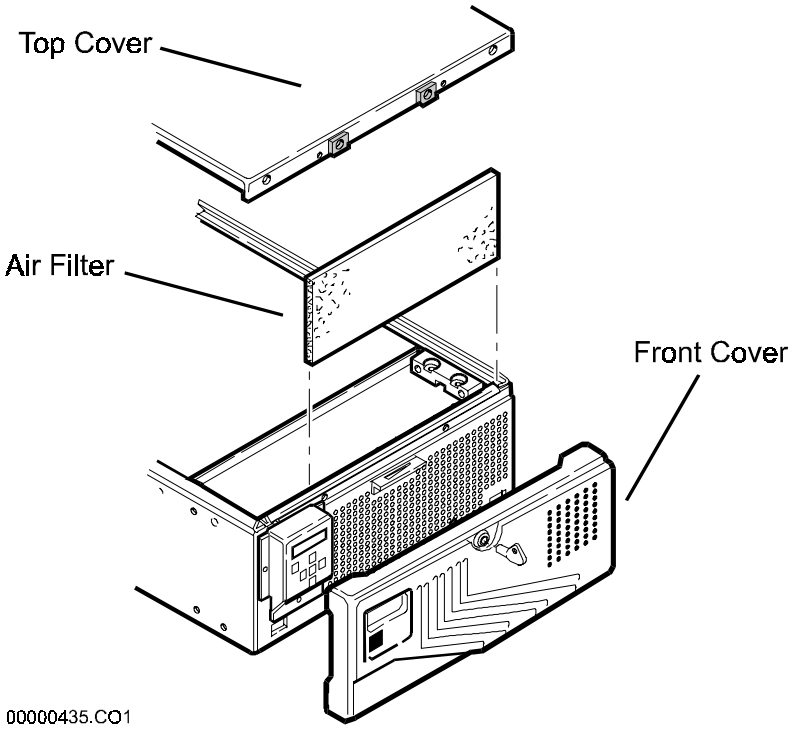



**Figure 14 Array Enclosure Air Filter Removal/Replacement**

## Failure Detection and Troubleshoot-ing Guidelines

These topics are discussed on the following pages:

- Failure indicators
- Built-In Self Test (BIST) failures
- Drive test failures
- Disk drive failures
- Over-temperature failures
- Troubleshooting guidelines

## Failure Indicators

When a failure occurs on the array, an audible alarm sounds, if enabled, and the display/operation panel reports the nature of the failure condition.

### Audible Alarm

To turn off the audible alarm, press any key on the display/operation panel (except RESET). Write down any error codes that are displayed. Pressing a key will cause the display to change to a different message.

### Error/Failure Messages

The display/operation panel shows error codes and failure messages that direct you to the source of failure. If there are no failures, the panel will read `ON LINE` (or assigned array name) `STATUS: OK`.

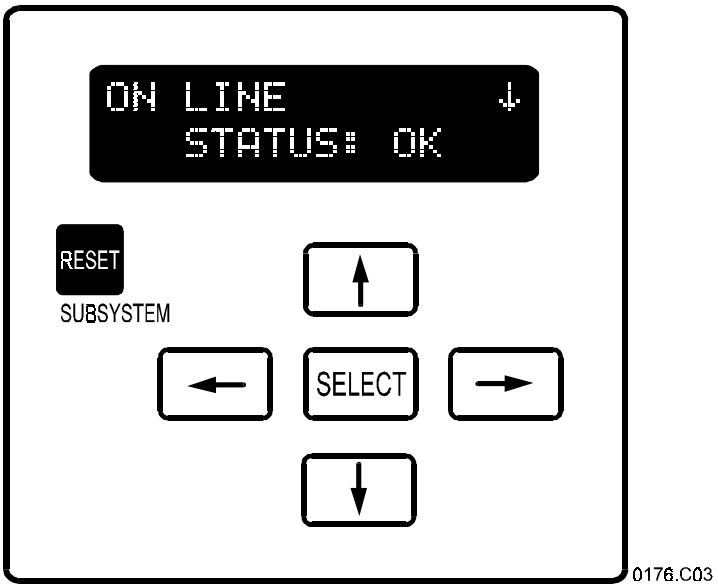



**Figure 15 Display Status**

As described on the following pages, you may encounter the following types of failures:

- Built-In Self-Test (BIST) failures
- Drive test failures
- Disk drive failures
- Over-temperature failures

## Built-In Self Test (BIST) Failures

During power-up, or after you push the RESET button on the display/operation panel, the array will automatically run a Built-In-Self-Test. This test thoroughly exercises array hardware and checks the following:

- Controller board components and functionality
- Display/operation panel functionality
- Firmware code checksum
- SCSI termination for single-ended arrays

You can reset the array and run BIST whenever you want to check the array internals.

### Indicators

- The audible alarm will sound, if enabled. After the alarm has begun to sound, it will go silent after any key is pressed. The alarm cannot be disabled in BIST mode.
- A BIST error will appear on the display/operation panel. A typical BIST error looks like this:

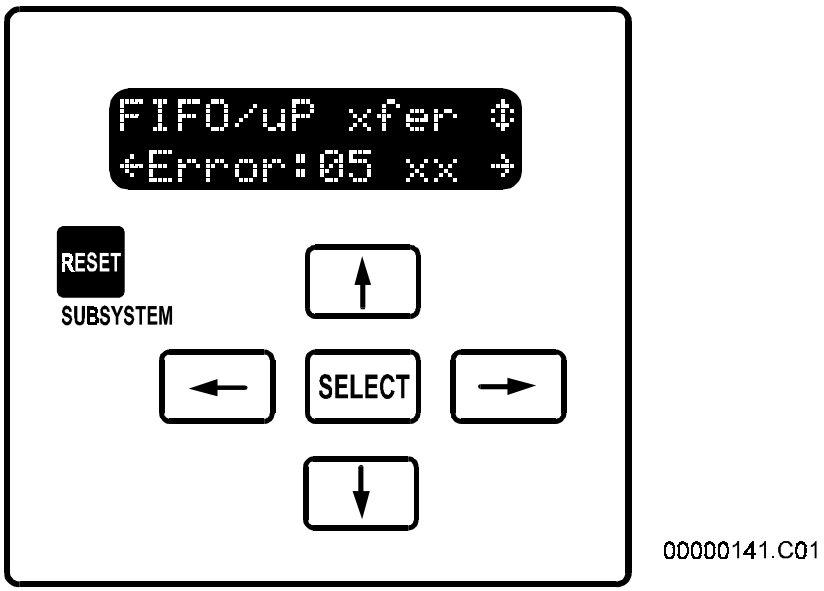



**Figure 16 Sample BIST Error Message**

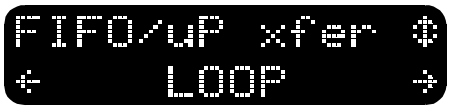
You have two options when a BIST error occurs:

- Choose to *continue with the BIST*—The failing test is skipped, and the rest of BIST is run.
- Choose to *loop on the error*—The failing test is retried infinitely; a percentage of error will be displayed. Press SELECT to stop the looping.

To choose the Continue response to a BIST error, press the left arrow key.


0402.001

To choose the Loop response to a BIST error, press the right arrow key.




00000143.001

When your option, either LOOP or CONT, is displayed, press SELECT to implement that option. LOOP indicates that the array will repeat that particular test if SELECT is pressed. CONT skips the failed test and continues with the other BIST tests when you press SELECT.

## Handling

| If you see this | Check or replace this |
|---|---|
| SCSI BUS IS HELD<br>*WAITING* | Check SCSI bus termination (single-ended arrays only). Terminator may not be present, may be broken, or the wrong kind. |
| | Disconnect the array SCSI cable from Host and reset the array. If BIST now passes, the problem lies in the host system SCSI interface. Check the host SCSI adapter. |
| 366U test<br>Error!! 07 02 | Verify Termpower. Check that the TPR jumper is installed on the array controller board. |
| Meaning: External SCSI bus error. | Replace the array controller board. |
| | Note<br>If a differential controller board is unterminated, the BIST will complete without reporting the unterminated condition. During subsequent operation, various errors, apparently not related to the termination, will occur. In the event of unspecified error conditions, first verify that the differential termination is in place. |
| <test name><br>ERROR: xx xx | Replace array controller board. |

**Table 4: BIST Troubleshooting**

## Drive Test Failures

When the Built-In Self-Test (BIST) described previously has finished, a firmware-based drive test is executed that tests the integrity and functionality of each drive channel, including the capacity to rebuild and generate parity.

If a drive fails when tested, the drive is first shown on the display as S (spinning up); other drives that pass the drive test are shown as G (good). In the following example, drive 3 is shown failing the drive test.


0507.C01

When the drive test times out, drives that pass the drive test are shown as R and the failed drive is shown as F (drive 3 in the example).


0400.001

**Note** If multiple drives fail, the array will display a message similar to this message:


0515.C01

## Disk Drive Failures

The array will continue to function if one disk drive fails.

**Caution** When a disk fails, it should be replaced and a rebuild should be performed as soon as possible. See disk replacement and rebuild instructions later in this chapter.

### Indicators

- Display/operation panel shows an F as status for the drive that has failed
- Audible alarm sounds (if enabled)

### Handling

| If you see this | Check or replace this |
|---|---|
| ON LINE<br>RRRR-RRFR-R<br>Meaning: Drive 3 in the array has failed | The order of the drives in the status display is:<br>9876_5432_1<br>with 1 being the rightmost drive in the unit. The LED for the failed drive will be out.<br>Replace failed drive and rebuild. |

**Table 5: Disk Failures**

## Over-temperature Failures

A temperature sensor mounted on the array's controller board signals over-temperature status. Each status is triggered at a different temperature.

### Indicators

- Display/operation panel displays one of the following messages:

  TEMP WARNING (user-definable, 45 degrees C default)
  TEMP CRITICAL (standard: 50 degrees C)

- Audible alarm sounds (if enabled).
- If TEMP CRITICAL displays, all drives will be spun down (if enabled).

### Handling

| If you see this | Check or replace this |
|---|---|
| TEMP WARNING<br><br>Meaning: Array's internal temperature has exceeded the first over-temperature threshold (the warning threshold). | Check room temperature. |
| | Check that the airflow from the front to the back of the array is not impeded. Check that the air filter is clean. |
| | Check that the top cover is on the array. |
| | Check that the fans are working. Replace if necessary. |
| TEMP CRITICAL<br><br>Meaning: The array's internal temperature exceeds 50$^{o}$C, the critical threshold. | Check the power supply for overheating. Replace if necessary. |

**Table 6: Array Temperature**

If the array's temperature exceeds either the WARNING or CRITICAL threshold, the alarm sounds and the appropriate message appears on the display/operation panel. Both the alarm and the display message will remain until you touch a key on the panel (the up-arrow key is preferred to clear the alarm because it will not clear the error display).

Even if the temperature has gone below both over-temperature thresholds, this setup ensures that you will be aware of an over-temperature situation, even if the temperature returned to normal before you could intervene. When the alarm and display message have been cleared, you can determine the array's current temperature by invoking the TEMP SENSORS command in the display/operation panel ARRAY INFO menu.

## Troubleshoot-ing Guidelines

When a component fails in a 6500 disk array, it is most often easily traced and fixed. There are occasions, however, when the problem may not be so straightforward, e.g., when unusual applications produce inconsistent results.

For the best results, use these tips to troubleshoot the array:

- Eliminate the obvious possibilities first (start with component exchange).
- Change only one item or setting at a time.
- Keep a log, or take notes on the progression of the problem.
- Record all error messages and status codes.
- If you can’t find a solution, contact your service provider.

## Hardware Field-Replaceable Units (FRUs)

The remainder of this chapter describes Field-Replaceable Units (FRUs) and replacement procedures for Ciprico's 6500 arrays. Procedures in this section cover removal and replacement of the following assemblies (see “Field Replaceable Units (FRUs)” on page 4-13):

- Enclosure top cover
- Controller board
- Display/operation panel
- Power supply
- Cooling fans
- Power switch
- Disk drives
- Replacing EEPROMs (for firmware updates)

## Field Replacement Guidelines

Observe the following guidelines when removing and replacing 6500 array hardware as described on the following pages.

**Caution** Power down the array before connecting or disconnecting communication cables.

**Warning** Power down the array before you move it or before you remove the enclosure cover. Also, power down the array before you connect or disconnect its SCSI cables.

**Warning** Observe standard Electrostatic Discharge (ESD) precautions: (1) whenever the top cover is removed from the enclosure and the controller board is exposed, and (2) when handling disk drives. We strongly recommend using a static discharge strap to prevent damage to the equipment. Failure to use a static discharge strap may void your warranty.

## Location of FRUs in the Array

“Field Replaceable Units (FRUs)” on page 4-13 identifies 6500 array Field-Replaceable Units (FRUs).

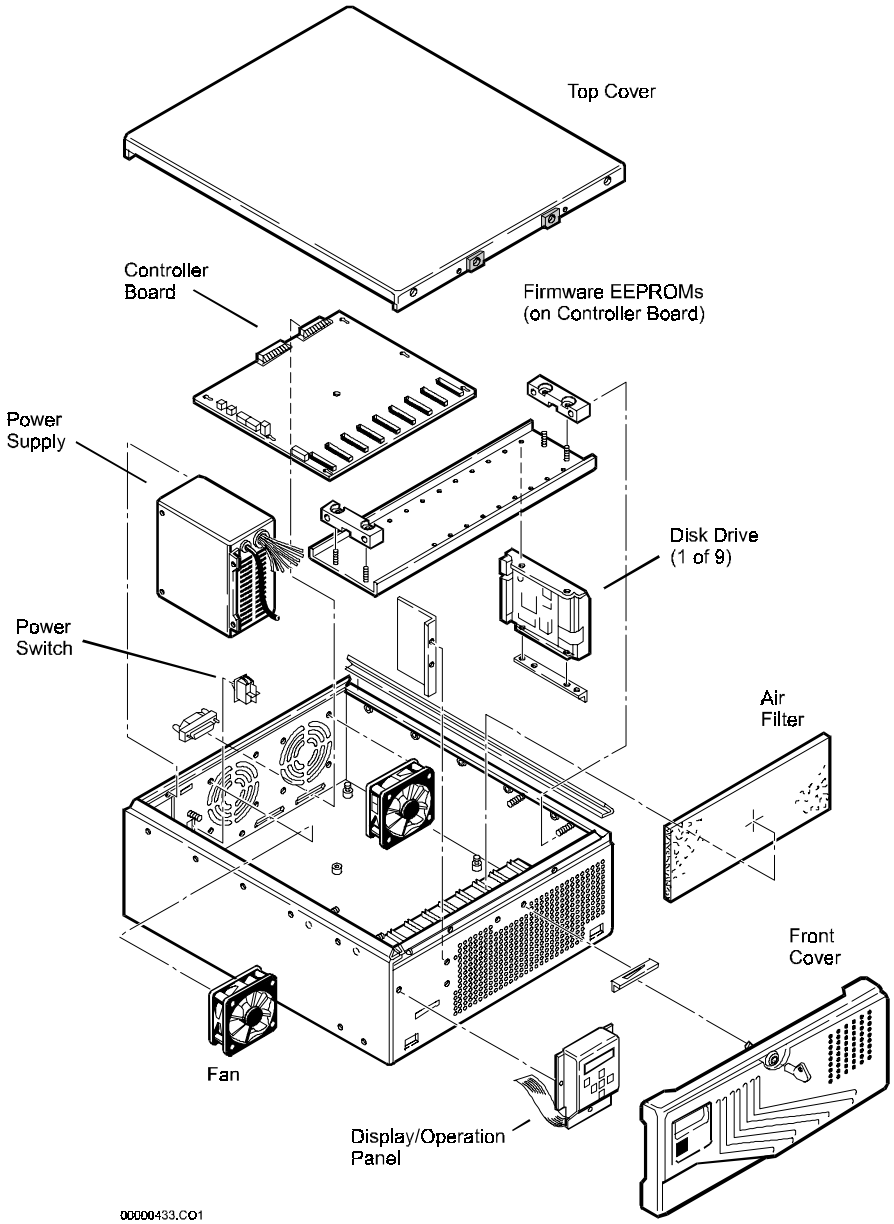



**Figure 17 Field Replaceable Units (FRUs)**

## Enclosure Top Cover Removal

1. Power down the array.
2. Remove AC power cord.
3. Unlock and open front cover of enclosure (see the figure below).
4. Remove the screws in the enclosure's front surface that secure the top cover to the enclosure.
5. Lift the front of the top cover.
6. Slide the top cover toward the rear of the enclosure to disengage the cover's hooks from their slots.
7. Lift top cover from enclosure.

## Replacement

Reverse the steps above.

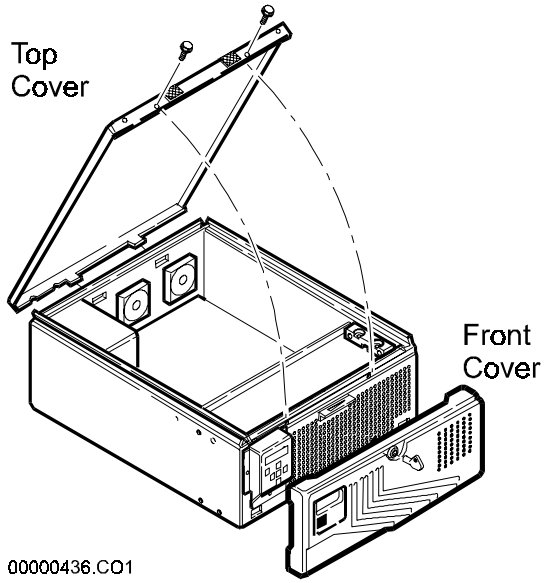



**Figure 18 Top Cover Removal**

## Controller Board Removal

1. Perform top cover removal procedure as described previously.
2. Disconnect the array from the SCSI bus. Remove terminator (if used).
3. Remove jack screws for SCSI cables and disconnect all power, drive, and display cables connected to the controller board.
4. Remove the screw at the center of the controller board. Slide the controller board forward slightly to align the mounting bosses with the enlarged portion of the board's mounting keyholes. Then carefully lift the controller board out of the array enclosure.

## Replacement

Reverse the steps above.

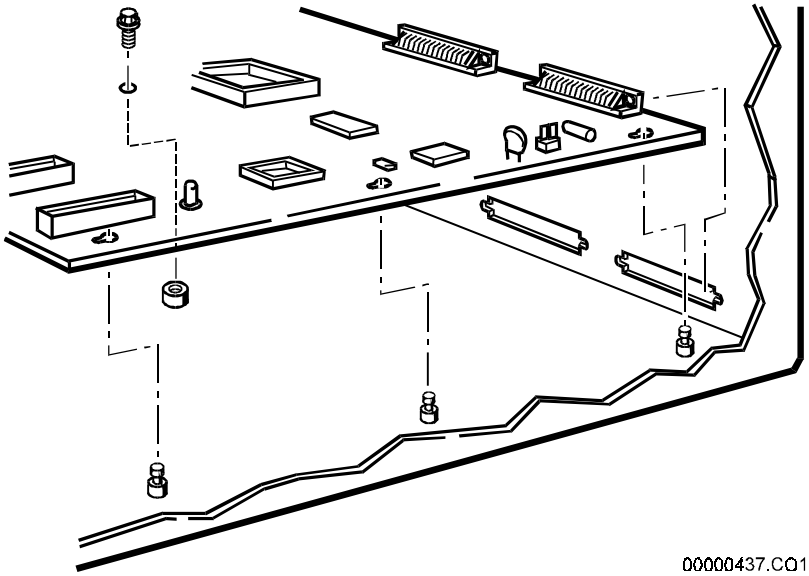



**Figure 19 Controller Board Removal/Replacement**

## Display/ Operation Panel Removal

1. Perform top cover removal procedure as described previously.
2. Disconnect the display/operation panel's ribbon cable from the controller board at connector J0401 (see the figure below). Also remove the cable from the clip on the side of the enclosure.
3. Remove screws that hold the panel housing to the front of the array.
4. While lifting the panel away from the array enclosure, guide the ribbon cable connector through its slot to free it from the enclosure.

## Replacement

Reverse the steps above.

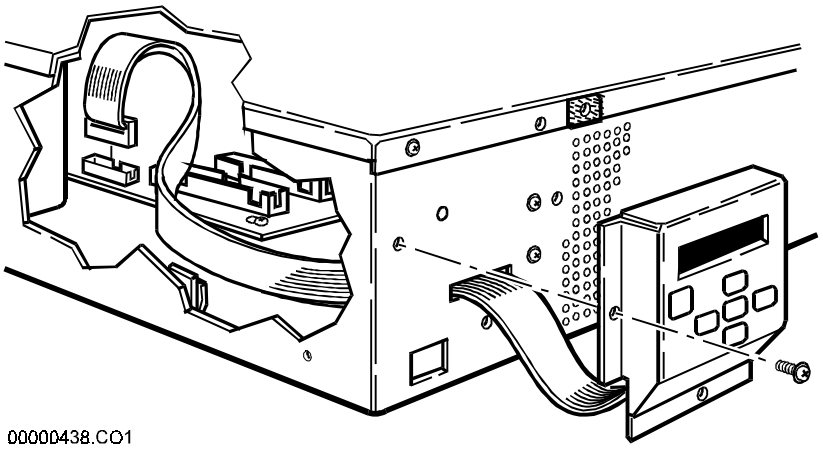



**Figure 20 Display/Operation Panel Removal and Replacement**

## Power Supply Removal

1. Perform top cover removal procedure as described previously.
2. Disconnect power supply from power switch (see the figure below). Note wire positions on power switch terminals (see “Power Switch Removal” later in this chapter). Then remove four power supply lugs from these terminals.
3. Remove nut that secures power supply ground wire to enclosure.

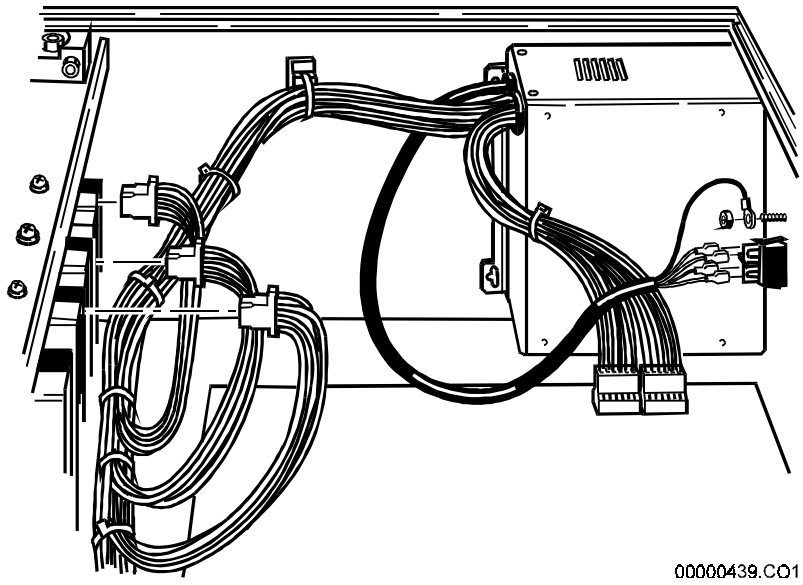



**Figure 21 Power Supply Removal—Electrical Disconnection**

4. Disconnect power cables from their connectors on 9 disk drives.
5. Disconnect power cables from the controller board.

6. Remove four screws that attach the power supply to the rear of the enclosure (see the figure below).
7. Unfasten the plastic retaining straps holding the drive power cables in place.
8. Lift the power supply out of the array enclosure.

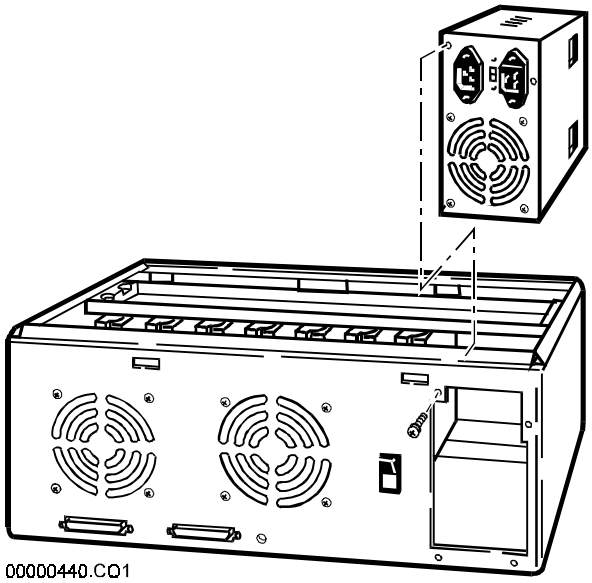



**Figure 22 Power Supply Removal—Mechanical Disconnection**

## Replacement

Reverse the steps above.

**Caution** Verify that the Power Voltage Selection Switch setting on the replacement power supply matches the input power source (115 or 230 VAC). The switch is located between the two power cord connectors on the rear panel of the power supply.

## Cooling Fan Removal

Each 6500 array contains two cooling fans. To remove either of them, perform the following steps.

1. Perform top cover removal procedure as described previously.
2. Disconnect the fan's two-wire power connector from its receptacle in the controller board. (See connectors J1801 and J1802 in the figure below.)

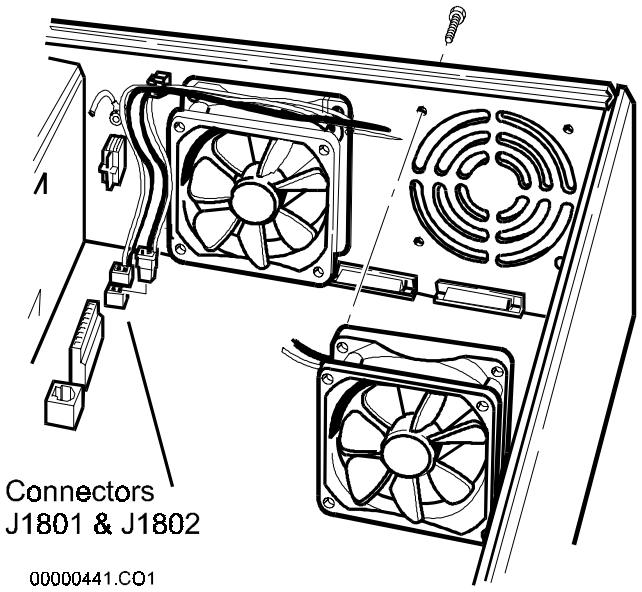



**Figure 23 Cooling Fan Removal/Replacement**

3. Remove the four screws securing the cooling fan to the rear of the enclosure.
4. Remove cooling fan from enclosure.

## Replacement

Reverse the steps above.

## Power Switch Removal

1. Perform top cover removal procedure as described previously.
2. Disconnect power switch from power supply as follows:

   Note orientation of switch: the “l” marker is up; the “O” marker is down.

   Note wire positions on switch, then remove the four wires from their connectors on the power switch.
3. Using fingers and/or a flat-blade screwdriver, compress the plastic lock tabs that secure the switch to the enclosure wall and push the switch through the back of the enclosure.

## Replacement

Reverse the steps above. Use the figure below to make correct connections to the power switch terminals.

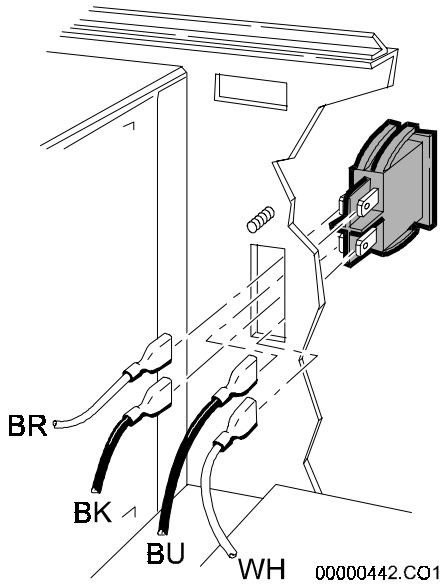



**Figure 24 Power Switch Removal/Replacement**

## Drive Failure, Replacement, and Rebuilding

The following pages contain information you will need to handle 6500 array drive failures, drive replacement, and drive rebuilding.

When all 9 drives are installed in the subsystem, the failure of one drive does not affect performance. The failure is reported through the display/operation panel. An alarm will sound if enabled.

The loss of a second drive can cause a catastrophic loss of data. To ensure continued array operation without data loss, a failed drive should be replaced and its data rebuilt as quickly as possible.

**CAUTION** If you are formatting a drive or rebuilding data on a drive,

- do **not** reset the array by any method,
- do **not** remove the array's SCSI terminator, and
- do **not** turn off the power to the array.

### Determining Drive Failure

The array uses the following conditions to identify a failed drive:

- The drive does not pass drive tests or fails in command time-out.
- A single drive is unformatted or from another set.
- Drive error thresholds.

If any of the above conditions are met, the controller will spin-down the drive and report the failure.

### Reporting Drive Failure

In the 6500 array, drive failures create a SCSI Unit Attention condition in the array if the `RPT AS RECOVER` option is not enabled and unit attention reporting is enabled.

Following is the conditional logic of reporting for drive failures. In the event of a drive failure: if the alarm is enabled, then the alarm will sound; if recovered error reporting is enabled, then a recovered error will be reported; if recovered error reporting is not enabled but Unit Attention reporting is enabled, then a Unit Attention condition will be reported; if neither recovered error reporting nor Unit Attention reporting are enabled, then no error will be reported.

During a Unit Attention condition, the next command received from each initiator is ignored and the array reports a Check Condition status. When the host requests sense data, it will receive an Additional Sense Code indicating the general type of failure and an Additional Sense Code Qualifier offering further detail. For more information about Additional Sense Code and Qualifier, contact your trained service technician.

**Note** If a second data drive has a fatal error as described above, the subsystem will power-down the failed drive and start reporting `NOT READY`.

## Drive Failure Indications

When a drive failure occurs, the following events will follow:

- The display/operation panel will immediately change from `ON LINE` (or assigned array name) `STATUS: OK` to


0409.001

  in which `F` denotes the position of the disabled drive (in this example, drive 3—the third drive from the right).

- The audio alarm will be activated (if enabled).

## To Turn Off Alarm, Press SELECT Key

To turn off the audio alarm temporarily, press the SELECT key or one of the arrow keys. Doing so will move the display to a new menu item and erase any hexadecimal error codes that may have been showing on the display. (Note that these error codes are nonvolatile and can be accessed at any time for service purposes.)

## Disabling a Failed Disk Drive

This procedure allows you to disable one drive in the array. The array stops operations on the selected drive and allows it to be physically removed.

**Note** The array prevents any drive from being disabled if another drive in the array is currently failed or disabled.

The procedure in the following example disables Drive 5.

1. Press the down arrow on the display/operation panel, then press the right or left arrows until the `FUNCTION SELECT/DRIVES` menu is displayed.
2. Press the down arrow.
3. Press the right or left arrows until the `DISABLE DRIVE #` menu is displayed.
4. Press the down arrow.
5. Press the right or left arrows until the desired drive number (e.g., 5) is displayed.
6. Press SELECT. The selected drive is disabled.

## Disk Drive Removal

1. Perform top cover removal procedure as described previously.
2. Identify the drive to be replaced. As viewed from the top front of the array, the drives are numbered as follows (from left to right):
   9 8 7 6 5 4 3 2 1
3. Detach the drive's power cable and data cable. (Detach the data cable from both the controller board and the unit.)
4. Remove the two screws that secure the drive to the plate above the drives (see the figure below).
5. Slide the drive toward the rear of the enclosure until it is free of the card guides and remove it from the array.
6. Using a screwdriver, detach the drive's mounting bracket and save it for use in installing the replacement drive.

## Disk Drive Replacement

Reverse the steps above

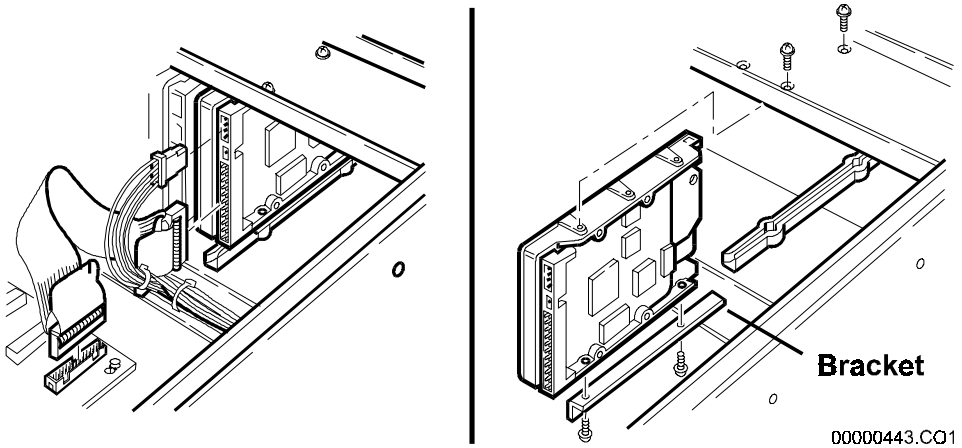



**Figure 25 Disk Drive Removal (Rear View)**

## Drive Setup Requirements

Replacement disk drives from Ciprico are preconfigured, ready for installation in the array. Replacement drive jumpers must be configured to identify the drive as a "master" without a slave unit, or as "one-drive-only."

## Types of Rebuilds

The next task required is to rebuild data onto the new drive in the array.

In this nine-disk array, eight drives are used for data storage and the ninth for parity checking. No matter which drive is replaced, it is possible to use the remaining drives to reconstruct the missing information.

### Off-Line Rebuild

An off-line rebuild occurs when the subsystem is off-line and remains off-line throughout the rebuild process. During an off-line rebuild the array will be unavailable for use. To complete the rebuild in the shortest amount of time, do an off-line rebuild, with the percentage of time dedicated to rebuilding set to 99%.

### Percentage Rebuild

A percentage rebuild occurs when the subsystem is on-line. During a percentage rebuild the drive's data is rebuilt concurrent with other operations. The percentage of time allotted to the rebuild process can be selected via the display/operation panel. Completion time for a percentage rebuild will vary with the percentage selected and the intensity of system activity directed at the array and the size of the disk.

### During Rebuild

Following is a brief description of what happens as the array rebuilds a drive. The controller board will:

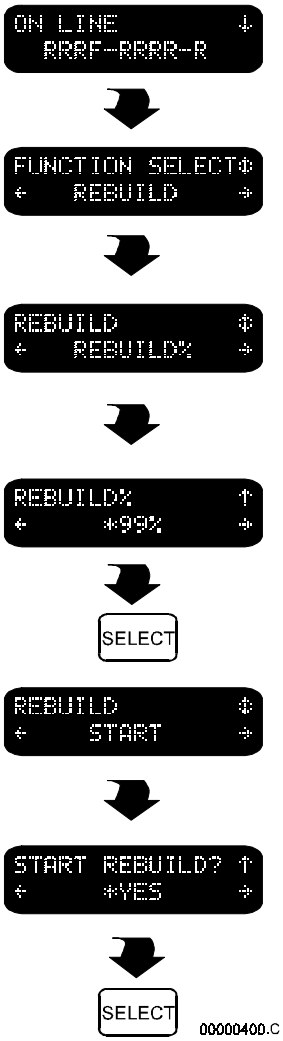
1. Apply power to the replacement drive's drive spindle motor, spinning up the drive.
2. Rebuild the data. In this step, data is read from other drives and reconstructed on the new drive.

**Note** If the rebuild is interrupted, for example, if the array is powered down or the rebuild is canceled, the process will terminate in an orderly manner. However, when the rebuild is re-initiated, it will not resume where it stopped but will start over, repeating both of the above steps.

### Completing the Rebuild

Upon completion of the rebuild process, the display/operation panel will revert from indicating the type of rebuild in process and will display `REBUILD DONE STATUS: OK`. Subsystem operation will continue normally.

## Initiating a Rebuild




Once a drive has failed and been replaced, you must rebuild the data to regain array redundancy. To perform a rebuild, follow these steps:

1. Press the down arrow key on the display/operation panel to get into the menu system. The top line of the display will now read FUNCTION SELECT.

2. Press the right or left arrow key until you see REBUILD. Press the down arrow key to get into the REBUILD menu.

3. OPTIONAL: Find the REBUILD% option by pushing the right or left arrow key. Press the down arrow key to get to the rebuild percentage options.

4. OPTIONAL: Choose the percentage rebuild you would like to use (10, 50, or 99). You must press SELECT for a new percentage to take effect. An asterisk will appear next to your chosen percentage value.

5. Press the up arrow key to return to the top of the REBUILD menu.

6. Press the right arrow key once until you see START. Press the down arrow key to get to the START REBUILD? option.

7. Choose YES. Press SELECT to begin the rebuild now.

The display/operation panel will now display the message:

REBUILDING.....XX%

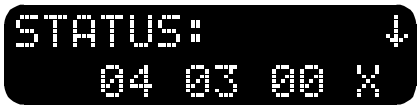
The displayed percentages are defined in the following table.

| When display panel shows: | it indicates: |
|---|---|
| 1% | Rebuild initialization |
| 3% | Testing drive |
| 4% | Testing capacity |
| 5% - 54% | Not displayed |
| 55% - 95% | Rebuilding drive's data |
| 96% | Write system sector |
| 100% | Writing new system sectors to all drives and cleaning up following the rebuild process. |

**Table 7: Rebuild Message Definitions**

## Drive Error Code During Rebuild

If a drive **other** than the drive being rebuilt encounters an error during the rebuild operation, the error code shown below appears, with the "X" position displaying the number of the affected drive:




00000363.001

If a drive being rebuilt encounters an error during the rebuild operation, the error code shown above appears **without** the "X" drive identifier displayed.

**Note** This type of error is most often some type of media error.

Code in this message is read as follows:

| Code | Meaning |
|---|---|
| 04 | Hardware Error (Sense Key) |
| 03 | Write Fault (Additional Sense Code) |
| 00 | Drive Not Ready (Additional Sense Code Qualifier) |
| X | Number of Failed Drive (Field Replacement Unit number) |

**Table 8: Error Code Meanings**

The failed drive should be replaced immediately.

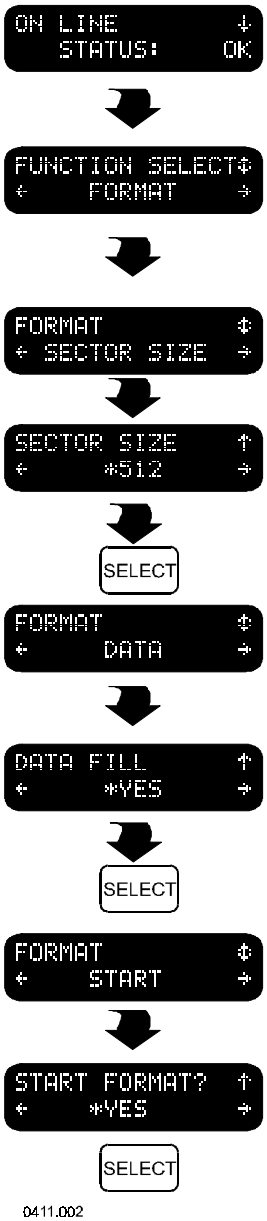
If the previous message is ignored, the failed drive not replaced, and a Reset started, a second message is displayed at the completion of the Reset. This error message should be ignored.

## Formatting the Array

A drive that is not formatted for the array (one lacking a 6500 system sector) will have a U displayed as its status. All arrays are formatted completely before shipment. If a message like the following example (a message containing a U for the status of any drive) is displayed, you will have to format the array.


0410.001

The following procedure formats the entire array and writes a “system sector” on each disk. Formatting destroys ALL data on the array.




0411.002

**Caution** The following actions must not occur during formatting: The array must not be reset by any method. The SCSI terminator must not be removed from the array. The array must not be powered down.

1. Press the down arrow on the display/operation panel, then press the right or left arrows until the FUNCTION SELECT/FORMAT menu is displayed.
2. Press the down arrow.
3. Press the right or left arrows until the SECTOR SIZE menu is displayed.
4. Press the down arrow to view the SECTOR SIZE setting. If this setting is incorrect, press the right or left arrows until the desired Sector Size is displayed, then press the SELECT key.
5. Press the up arrow.
6. Press the right arrow once to display the DATA FILL menu.
7. Press the down arrow to view the DATA FILL setting (ON/OFF). If the setting is incorrect, press the right arrow once to switch it, then press the SELECT key.
8. Press the up arrow.
9. Press the right arrow once to view the START menu.
10. Press the down arrow. The START FORMAT? setting must be set to YES. If needed, press the right arrow once to display YES.
11. Press SELECT.

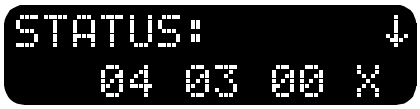
**Note** The format process begins for the entire array. Depending on the array configuration, formatting can take from 10 to 20 minutes to complete. The table below identifies how to interpret the display/ operation panel messages during the format process.

| When display shows: | It indicates: |
|---|---|
| 1% | Format begins |
| 2% | Transferring format data from the host |
| 3% - 49% | Not displayed |
| 50% - 55% | Reading capacity for all drives |
| 55% - 94% | Data fill (writing inter-drive parity) |
| 95% - 97% | Writing new system sectors to all drives and cleaning up following the format process. |

**Table 9: Array Formatting Message Definitions**

## Formatting Error Code

If a drive fails during a format operation initiated through the display/operation panel, the error code shown below appears:




00000363.001

The code is read as follows:

| Code | Meaning |
|---|---|
| 04 | Hardware Error (Sense Key) |
| 03 | Write Fault (Additional Sense Code) |
| 00 | Drive Not Ready (Additional Sense Code Qualifier) |
| X | Number of Failed Drive (Field Replacement Unit number) |

**Table 10: Error Code Meanings**

The failed drive should be replaced immediately.

If the previous message is ignored, the failed drive not replaced, and a Reset started, a second message is displayed at the completion of the Reset. This error message should be ignored.

## Correct the Formatting Error

To correct this condition, it is necessary to replace the failed drive and re-issue the *Format* command.

## Updating Firmware

This procedure describes how to swap new chips containing updated firmware with the chips currently installed on the controller board. The array is equipped with a matched pair of 32-pin EEPROMs. One is labeled EVEN and the other ODD.

### Replacing EEPROMs

1. Perform top cover removal procedure as described previously in this chapter.

**Caution** During the following procedure, use standard precautions against static (wear a static wrist strap or ground yourself by touching one hand to the cabinet).

2. Using even pressure to avoid bending pins, remove the EVEN firmware chip

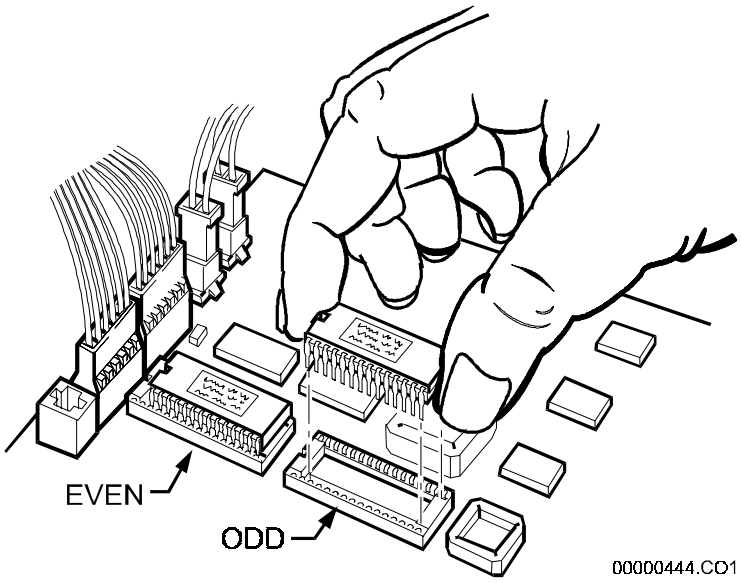



**Figure 26 Chip Orientation and Location on the Controller Board**

3. To orient the chip properly, align the notched end of the chip with the notched end of the socket.

   Once you have aligned the replacement chip correctly, insert it into the appropriate socket. The location of the socket and the orientation of the chip are shown in the above figure.

4. Using even pressure to avoid bending pins, remove the ODD firmware chip.

5. Orient, align, and install replacement chip.
   Align the notched end of the chip with the notched end of the socket. Once you have aligned the replacement chip correctly, insert it into the appropriate socket using even downward pressure.

6. Replace the array's top cover.

7. Apply power to the array.

8. Observe the display/operation panel power-up sequence. When the array has completed the BIST (Built-In Self Test), you should see the STATUS: OK message.

# Numerics



# A



# B



# C



# D

# *E*



# *F*



# *H*



# *I*

# L



# M



# N



# O



# P



# R



# S

## *T*



## *U*



## *V*



## *W*



## *X*